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THE LATEST MAXIM MACHINE GUN.

THE first guns were actually supplied for trial to the British government in March, 1887. The piece was not to exceed 100 lb. in weight, it was to fire 400 shots in one minute, 600 in two minutes, and 1,000 in four minutes. Three guns submitted passed these tests easily, the last delivering 1,000 rounds in a minute and a half. Having passed the sand and rust tests, these guns were purchased. Four competitive trials took place on the Continent in 1887. In the first of these a Gardner gun, which had hitherto proved to be the best, was tried against the Maxim. The Gardner weighed 200 lb. for the gun and 100 lb. for the stand, the Maxim gun 50 lb., with 60 lb. for the stand. The Gardner when worked by four men scored 300 rounds in sixty-one seconds, any faster work jamming the action. One man fired the Maxim 334 rounds in thirty-five seconds, with a greater number of hits. At 800 meters range the pieces were fired again. The Gardner fired 300 rounds in a minute, and the Maxim 334 rounds in thirty-four seconds; similar results following at 1,300 meters range, except that the care necessary in aiming caused the fire of both guns to be slower. Two rows of dummies were then fired at. They were arranged twenty in a row, with 20 meters distance between the rows. The Maxim again was victorious, killing thirty-five out of the forty dummies in three-quarters of a minute, so that the committee reported in favor of the Maxim on all points.

At another trial the Maxim competed against the two-barrel Gardner and the five-barrel Nordenfelt. The pieces were worked by one, four, and three men respectively. The Maxim fired 3,000 rounds with no hitch, and stood a severe sand and rust test, the feed box and magazine being filled with sand. Fired for rapidity, the Maxim scored 400 rounds in 40 seconds, and 334 in 32 seconds. The Nordenfelt came next in order of speed, attaining 200 rounds in 23 seconds. Other experiments might be quoted. The Maxim exhibited the special advantages of allowing of its mechanism to be taken out, cleaned, and oiled by hand without instruments, and of accuracy in shooting, owing to a single barrel being employed instead of two or more whose axes cannot be perfectly parallel.

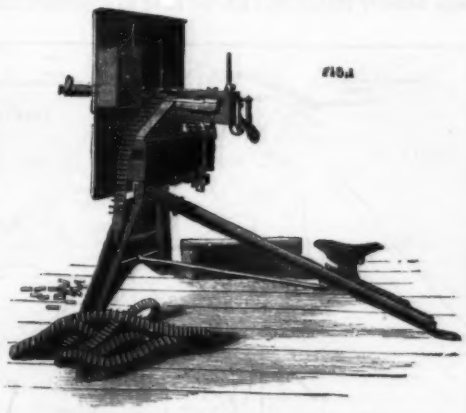
No gun which competed with the Maxim fired more than 1,000 consecutive rounds. After that number had been discharged in the space of about four minutes, the barrels became too hot to continue firing at high speed. In the Maxim, overheating is prevented by the water jacket. It has been found that water begins to boil after 600 rounds have been fired, and subsequently nearly 1½ pints, or about 2 lb., of water are evaporated for every 1,000 rounds. The water is in contact with the actual barrel for about two-thirds of its length, being automatically admitted from a small cistern into the barrel casing by the recoil of the barrel, and escaping as steam at the end of the tube near the muzzle of the gun.

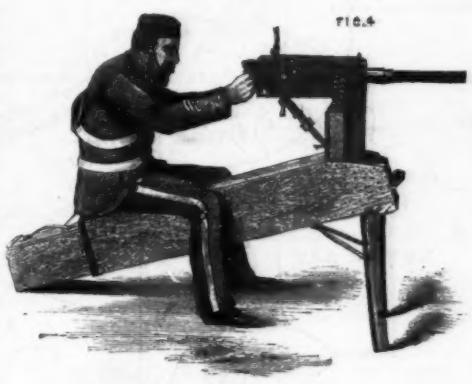
From Captain Mariani's report on the trial of the Maxim gun in Italy the following facts are taken. The automatic character of the Maxim gun renders it necessary only to hold back the trigger "to continue the firing until all the cartridges in the belt are exhausted. In this way the single gunner who operates the arm can give all his attention to aiming, and he never need fire without having first well aimed, and can always fire at the instant of aiming." In other mitrailleuses the action of the man who aims is often subservient to that of the man who operates the gun, and *vice versa*. Thus the marines found that it was not advisable to employ two men at the Gardner gun, one to aim and the other at the crank, yet only 240 rounds was the maximum number that could be fired in a minute if one man only were employed. This difficulty is most apparent in firing at a moving object. The Nordenfelt gun was fired 400 times in forty-one seconds, but only when the operating mechanic took a position which interfered with aiming the gun. The present form of the ten-barreled Gatling has discharged 104 rounds in less than three seconds, but it is very difficult to change the aim, so that the stream of bullets falls on one point.

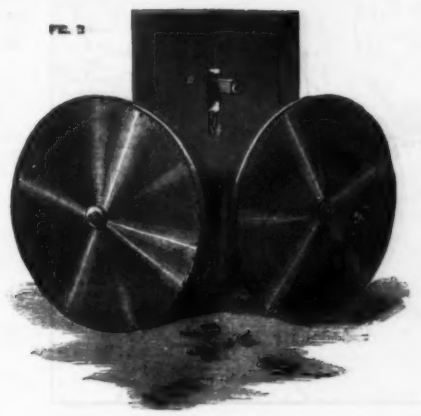
One merit in the Maxim system is "the fact that the gun ceases firing in the case of a misfire, so that jamming cannot take place till the gun is again worked, previous to which it should be examined carefully. It may be here noticed that the Maxim breech bolt, containing nearly the entire mechanism of the arm, can be removed and replaced, or carried off in case of threatened capture by an enemy. As to durability, the piece tried at Spezia fired 3,200 rounds there, previous to which it had discharged 4,000 rounds in Switzerland. It also fired 4,000 at the Polygon of Cirie, making in all 11,200 rounds. As to accuracy, at 500 meters range two lines of targets 3 meters high and 24 meters wide were placed side by side. Out of 100 rounds fired on the left target there were 62 hits. Then 1,000 were immediately fired on the left target, making 613 hits; and lastly 100 again on the right target, making 64 hits. On another occasion, at a range of 1,000 meters against two rows of targets of the above dimensions placed one behind the other, the following hits were made: The first series of 100 rounds gave 47 hits in the front target and 56 in the second; in the second series of 1,000 rounds there were 591 hits in the first and 494 in the second target; and in the third series of 100 there were 59 hits in the front and 61 in the second target. The ten-barreled Gatling is reported to have made in 100 rounds 47 hits in the first and 59 in the second target, under similar conditions. It will be seen that the firing at 1,000 m. was relatively better than that at 500. This can only be accounted for by the supposition that Mr. Maxim, who aimed the piece in the first trials, was less skillful than the member of the committee and Mr. Vickers, who acted for him on the second occasion. The belt which carries the cartridges takes some time charging; but it is easy to carry the rounds ready in belts. Objections have been made to the necessity for water in the jacket of the barrel; but from what has been already noticed as to the supply needed, it may be seen that the light weight of the Maxim more than makes up for the carriage of water.

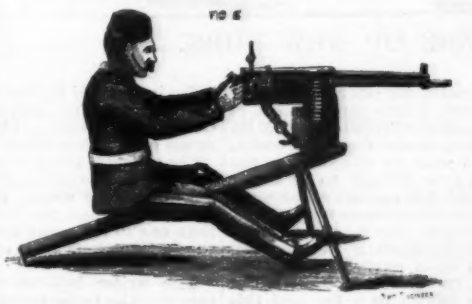
The Austrian committee on the Maxim made a preliminary trial in July, 1887, with two rifle-caliber Maxim guns—11 mm.—and were satisfied as to rapidity of firing, simplicity, and ease of manipulation, and as to the power of one man to work the gun. Further trials were made with a Maxim gun mounted on a tripod with shield for range and accuracy. At 200 m. 30 shots—all hits—were made in 3 secs. At 400 m. the same was repeated. At 600 m. 40 shots were made in 4·3 secs., giving 39 hits. At 800 yards there were 40 rounds in 4·3 secs.—all hits. At 1,000 m. 40 shots in 4 secs., producing 36 hits. At 1,200 m. 25 shots in 2·5 secs. gave 24 hits; and again, at the same range, 40 shots in 4 secs. gave 29 hits. At 1,400 m. 60 shots in 5·8 secs. gave 46 hits, and at 1,575 m. 60 shots in 6 secs. gave 45 hits. As to durability and serviceability generally, 13,504 shots were fired, the cartridges being supplied in belts, each containing 334 rounds, and an average speed of 10 rounds per second was obtained in all positions. Owing to a mistake as to the amount of charge to be used, springs were supplied of insufficient strength. The main spring gave way after 7,281 rounds, the striker after 10,223, and the buffer after 11,418 rounds; but these were easily replaced in a few seconds, and firing continued. The committee reported strongly in favor of the Maxim. After 6,356 rounds, the accuracy was found to be as good as ever. The report uses the following words: "Wet does not impair the mechanism; dust diminishes the speed of firing, but the mechanism, especially the feeding apparatus, was very susceptible to wet and dust combined. If certain reserve parts are supplied, and the buffer spring made stronger, the efficiency of this mitrailleuse seems guaranteed under all circumstances." This committee conclude their report with these significant words: "From the foregoing results, it is evident that the original favorable judgment formed after the preliminary trials was justified, and it can therefore be asserted that of all the systems of mitrailleuses hitherto tried, the Maxim is the best adapted to the purpose for which it is intended. The Maxim system has likewise undergone an exhaustive trial in France, and one gun has fired 20,000 rounds without any hitch or mishap. The trial in the United States was likewise successful, but details have not yet come to hand."

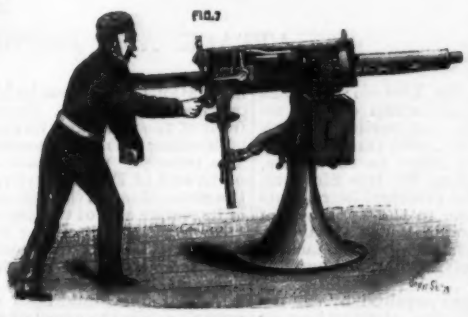
The illustrations tell their own tale to a great extent. Fig. 1 is chiefly given to show the supply of cartridges on bands, joined so as to form a continuous stream. Fig. 4 represents an automatic gun without a water jacket, made as light as possible, and so arranged that the case in which it is packed for transport forms the tripod from which the gun is fired. The legs fold backward against the bottom of the case, and the swivel on which the gun is mounted also folds up, enabling the gun to be placed easily in the box; this case also holds 334 rounds of ammunition in a belt, ready for use. The gun thus packed can be carried anywhere by two men. Fig. 6 shows a gun mounted on a tripod which only weighs 19 lb. and folds up. The weight of the gun and tripod is 70 lb. Fig. 7 shows a 1-pounder automatic gun on a mounting suitable for fortress or board-ship fighting; a 3-pounder has now been made on the same principle. The gun has also been mounted on a cycle carriage, for the use of the cyclist corps recently formed, and seems likely to be of good service in this somewhat original capacity.—*The Engineer.*











THE LATEST MAXIM MACHINE GUN.

IN our SUPPLEMENT 650, June 16, 1888, we published a paper on the Photography of the Human Eye, in which, by a typographical error, the author's name appeared as Barr, instead of Starr. The paper was writen by Dr. Elmer Starr, of Buffalo, N. Y.

ATTACK AND DEFENSE OF NEW YORK.

By Lieut.-Colonel BUCKNILL, R.E. (Ret.)

DESIGNS FOR DEFENSE.

DOCKYARDS where men-of-war are built should be secure from attack, and should therefore be situated many miles up a tortuous river or inlet difficult to navigate at the best of times. Chatham is a practical example of this ideal.

The protection of large commercial shipping centers from purely naval attacks is easily effected if they be similarly situated. The great cities of London and New York are typical cases. It is not desirable that our own defenses should be discussed in detail, especially by one who for many years was engaged upon them at our war office. New York will, therefore, be selected, and a design for the sea mine defense will be drawn up and described.

The position of the mine fields should be retired from the open sea, both because they would then be more difficult to approach, and because the shelter would enable the miner to carry out the mooring operations in rough weather. Care must, however, be taken to moor some of the mines at or a little beyond the limits of bombarding range, and the remainder should be scattered in groups or fields as irregularly as may be compatible with their protection by light artillery, and especially quick-firing guns mounted in proper emplacements.

Absolute mine blocks, which are so fashionable, with their floating impediments telling a foe where the mines are laid, should be avoided. This method places too many eggs in one basket, and shows the position of the basket. A mine defense should be deep and narrow in plan, rather than wide and shallow; and the center of each channel should be mined more than the sides.

Mines should extend right through the defense, to the very last entrenchment. Sir Lintorn Simmons once said, "A gun for the defense which can be reserved until the attack is in the last period is worth anything" (R. E. Papers, vol. xviii, 1870); and the same remark applies to mines. In a letter to the *Times*, 1855, signed "B," and attributed to the late Sir John Burgoyne, we read, "One of the principal ingredients in defensive works is an obstacle to the approach of the assailants." On this principle mines should be moored so as to help the forts when they are attacked, by obstructing those portions of the channel outside the forts at engaging distances.

Small side channels that are not required by the defenders may be blocked by passive obstructions or mechanical mines, especially if these side channels are likely to prove of use to a foe in delivering boat attacks. Let us apply these principles to our example, New York.

This magnificent emporium of trade, whence radiate the pulsating arteries essential to the life of one of the greatest civilized nations the world has ever seen, is situated on a peninsula on the left bank of the River Hudson, and is covered from the open sea by the end of Long Island, between which and Staten Island the Hudson flows through the Narrows into an estuary about seven miles square (49 square miles), containing several channels divided irregularly by large banks, with about two fathoms over them at low tide.

Long Island, about 100 miles by 17, covers a large sound or arm of the sea, over 20 miles wide, that separates the island from the States of Connecticut and New York. At a distance of 12 miles from the city this sound narrows down to a width of 1¼ miles, and at 8 miles from the city it is only ¼ mile wide. Here two forts, one at Willets Point, on Long Island, the other at the extremity of Throg's Neck, on the opposite shore, protect the channel, which from this point inward is called the East River. Its width is still further reduced as it approaches the city, until finally at Hell Gate it is less than ¼ mile wide

Long Island thus protects the city from the sea, obliging any naval attack to be delivered on one or other of two intricate paths of approach. But the defense of an island against a foe who possesses the command of the sea is much more difficult than is that of the mainland of a country held by a courageous people and intersected by numerous lines of communication. Long Island, therefore, is at one and the same time a source of protection and a source of weakness. It gives strength to resist a purely naval attack, but is very vulnerable to a combined naval and military operation.

In these days it is impossible to prevent troops landing when the operation is covered by a fleet, and it is also impossible to check their advance so long as they advance in a parallel line and within the effective range of its artillery.

New York is open to capture by an operation of this nature, a strong force landing on Long Island from the Sound as near to the city as possible, and advancing by the East River shore, under the covering protection of a fleet, and assisting the ships by capturing the batteries or mining stations on that shore, which would thus be taken in reverse.

With Long Island in its present defenseless state such an operation would be quickly done, in spite of submarine mines, dynamite guns, plunging Davids, and what not. To describe a possible *coup de main* is to suggest a defense, and our cousins might do worse than spend some of their annual surplus in the construction of a string of forts between Jamaica Bay and East River. Taking things as they exist, the following arrangement of mines would give a strong defense to East River against a purely naval attack. In order to hamper any attack on Fort Schuyler, the navigable water to the west of Hewlett Point and Elm Point should be mined. For reasons already stated, the firing stations should not be located on Long Island, but on the opposite side. Ground mines can be used in front of the forts, and be charged with 600 lb. or 900 lb. of blasting gelatine, according to the depth of water. The principal firing station may be situated to the northwest of Fort Schuyler, near enough to be under the protection of the fort and far enough to be clear of its smoke and of the fire which it draws upon it.

An auxiliary observing station may be placed at M (see Fig. 86), or further from the shore, if M be considered too exposed to attack by a party landing from boats at high tide. But its position ought to be screened, and should not be known to a foe, and this remark applies to every observing station used in connection with sea mines.

The mines are shown as moored in four lines converging on M, and the cables would be carried to the back of Throg's Neck to the observing station at that place; this would connect with M by means of a three-cored cable, two cores being required for observing and one for telephoning. Lines 1 and 3 would be operated from one of the writer's plane table observing arcs, lines 2 and 4 from another, and there would be an observer to each core at M who would send a positive current for one alignment and a negative for the other, to the instrument shown on Fig. 76 *ante*.

These mines, being spread over a large expanse of water, would be most useful against vessels that might engage the forts at battering ranges.

The water to N of Willets Point could also be mined similarly, but Throg's Neck is a position excellently well adapted for a battery of dynamite guns firing both to front and rear, in which event the waters within a radius of a mile can be kept clear of mines.

In nearly every defense some of the side channels are a source of weakness. They should be blocked by mechanical mines, or by passive obstructions, or both combined. Thus two groups of mechanical mines may be placed between City Island and Rodman's Neck, if other considerations do not prohibit same, and another group may be placed off the rocks at Elm Point.

Abreast of Fort Schuyler a mine field may be formed consisting of four groups of electro-contact mines flanking a fairway mined with several pairs of observation ground mines. This fairway can be inclined so that its line of direction falls on Willets Point, and each pair of mines would be fired from the central station at Throg's Neck when a vessel came on the observed intersection. One of the writer's plane table arcs might be employed for this work.

These portions of the defense may collapse after due resistance, and other mine fields in rear should therefore be provided. One can be placed at Old Ferry Point, another at Clawson Point, and still another perhaps at the Brothers, each having a narrow fairway free of contact mines.

An attacking squadron that succeeded in forcing its way to the Brothers would be within shelling distance of the city, and terms would probably be arranged to prevent further operations.

Let us now turn to the principal commercial entrance to New York Harbor.

The attacking forces would here meet with numerous nautical difficulties. The deepest water over the bar is but 3¾ fathoms at low water, and the rise of tide at springs is less than one fathom—total, 22 ft. 6 in. at low and 28 ft. 6 in. at high water. First-class ironclads should therefore keep outside, and any attack on this side must be made by war vessels of smaller draught. The channels inside the bar are intricate, and skilled local pilots are required to take steamers into port. If some of the buoys and light vessels were only slightly shifted, the navigation of vessels would be made so difficult to strangers as to be well-nigh prohibitive. Moreover, the land is so distant and so hard to approach, owing to the flats that extend for

Fig. 86.

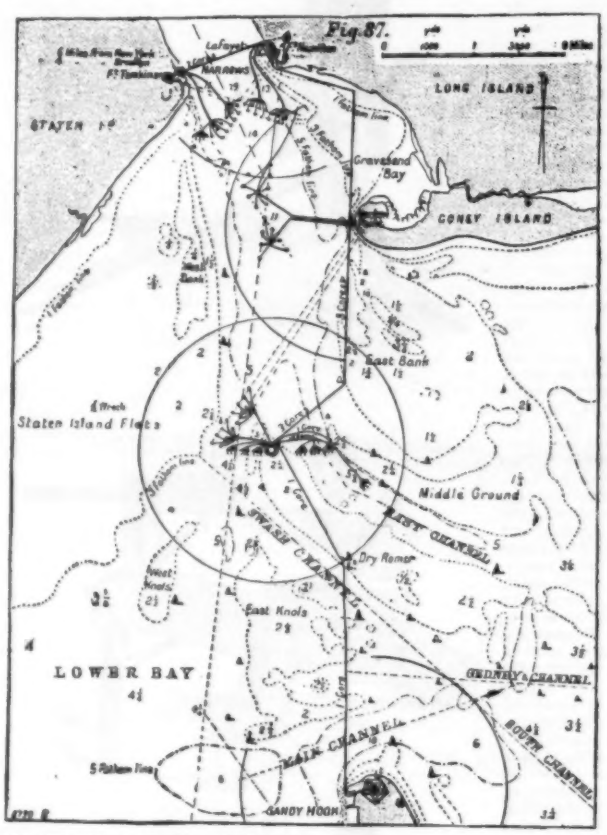


Fig. 87.

ATTACK AND DEFENSE OF NEW YORK.

miles in front of it, that a simultaneous attack by land could receive no assistance from the forces afloat. Combined operations like those suggested for the advance up the East River are therefore impossible.

Considering these things, it certainly appears that New York, like some other places, has a weak back entrance and a strong front door. Yet an attack *via* Sandy Hook and the Narrows seems to be feared more than one in the other direction, if one may judge from the fortifications now existing, especially at the Narrows.

The writer believes that the key of the lock for securing the main entrance to New York Harbor will be found at the inner end of the sand bank called the Dry Romer. This is ten miles from the nearest point of the city and eight from Brooklyn. The Narrows are only six miles from the city and four from Brooklyn, and vessels lying outside would be within bombarding distance of them both. Every effort should therefore be made to present an effective resistance to an attacking squadron before it comes so far.

The Swash Channel joins the main channel close to the north end of the Dry Romer, the navigable water being only 1,250 yards wide at this point. It is bounded on the west by the Staten Island flats, with an average depth of only two fathoms over them.

The East Channel is also 1,250 yards wide at the north end of the Dry Romer. This fine channel, although not much used by commerce, has 3¼ fathoms over the bar, and might be used by the attack in war, as it lies beyond the effective range of Sandy Hook Fort. All the rest of the harbor entrance is forbidden to vessels drawing more than 14 ft. or 15 ft., that is to say, to war vessels that would cross the Atlantic. An ironclad fort on the north end of the Dry Romer would consequently hold this entrance to New York, and with additional certainty if mines were placed in the channels on either side of it. As no fort exists there, the mines are all the more necessary, and some makeshift arrangement should be devised both for protect-

ing them against boat attack and for providing a firing station as close to them as possible. This could be done by floating a strong iron hulk to the spot, and then filling her with sand, leaving chambers on the north side for firing and observing stations, and mounting quick-firing guns on carriages disappearing through the deck, the guns remaining up when in action, and out of sight and protected as far as possible when not in action.

The mines can be arranged in various manners, and the plan shown on Fig. 87 provides for the main channel a combination of electro-contact and of observation mines, the latter being charged with 600 lb. of explosive and moored on the ground in two lines converging upon Norton Point. They are not placed directly across the channel, but diagonally, and so that the cross intersection firing may be effected from the temporary station near at hand. In this manner the west part of the channel becomes a fairway free from contact mines, and available for the traffic of the port. A plane table observing arc can be used, and a single core would be led to the alignment observing station on Norton Point, a second core would be required for telephonic communication, and a third core would be held in reserve, as spare. A single core should be carried on to Sandy Hook Fort, as shown, for communication, and perhaps it may be led into the Swash light vessel on the way. The East Channel can be closed by four groups of electro-contact mines.

In rear of the Dry Romer defense a second series of mines may be moored in the main channel off Norton Point, in order to hamper the attack on the Narrows. These mines should be scattered over a wide area, and observation mines may advantageously be resorted to, because vessels would not attack the Narrows at night. The mines can be charged with 900 lb. of explosive (the depth being about 11 fathoms), and can be moored on the ground in two lines crossing one another and directed, the one on a station near Fort Tompkins, the other on a station near Fort Hamilton.

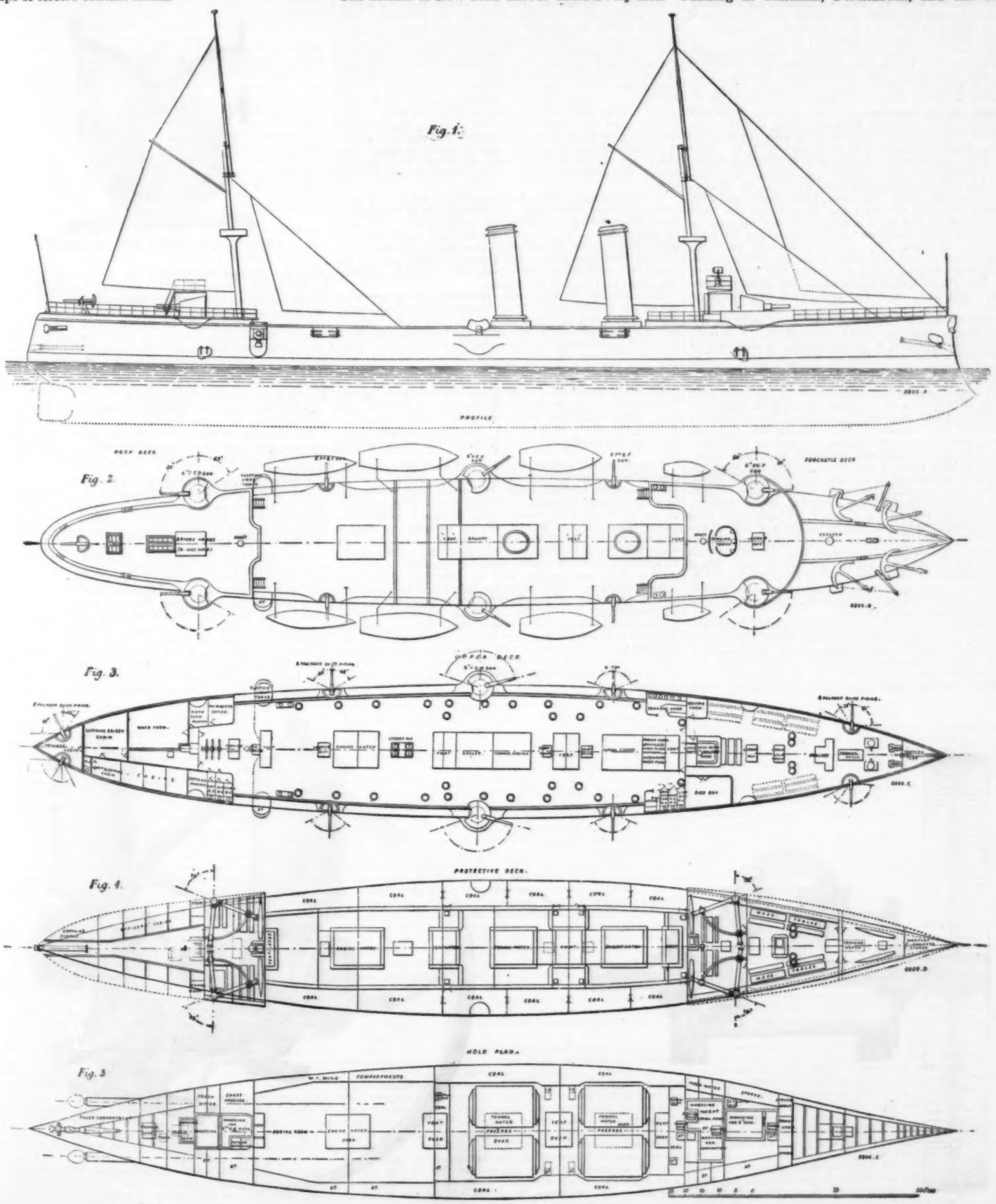
Still nearer to and in front of the Narrows, a further system of observation mines moored on the bottom in two rows forming a re-entering angle can be directed on the two stations last mentioned, and be fired therefrom, by double observation, one plane table observing are being used at each station and two cores connecting them for firing purposes. A third core of the seven-cored cable shown on the figure can be employed for telephonic communication. Two more cores would be required for the mines off Norton Point, and two cores would be held in reserve as spare. A group of electro-contact mines can be placed on each flank. The water is somewhat deep at the Narrows, and the defense can here be left to artillery and torpedo guns mounted on the heights on either side, and to locomobile torpedoes actuated from suitable positions on either shore.

The defense of New York harbor offers a very interesting example of the general ideas which govern the application of submarine mines. In every large harbor, however, the possible permutations and combinations are numerous, and no two designs drawn up independently, even by officers who have been trained in the same schools, are likely to be precisely similar.

Thus, in the example before us, many engineers might prefer to sow the Swash and East channels with mechanical mines, and to place a complete system of electrical mines in the main channel off Sandy Hook Fort, friend and foe alike being thus compelled to use this channel in time of war. Such an arrangement would be strong, and would deny the lower bay to a foe, but the defense would be somewhat disconnected, and for this reason would, I think, be weaker than the one proposed and illustrated in this paper. Moreover, inasmuch as a war may last through the winter months, and masses of ice come down when the Hudson River breaks up, mechanical mines in situations like the Swash would certainly be destroyed by self-ignition at such a time.—*Engineering.*

H. M. S. MAGICIENNE AND MARATHON.

WE give engravings showing the general arrangement of the most important vessels included in the programme of the British Admiralty for 1887-88. These were the five protective cruisers now building at Chatham, Portsmouth, and the Clyde,



H. M. S. MAGICIENNE AND MARATHON.

which include many new features in design and construction, and are a further development of a type of war ship which, although not yet tried in actual warfare, is looked upon favorably by some naval constructors as a valuable auxiliary to the much more powerful and fully equipped ironclad. The five vessels are named Medea, Medusa, Melpomene, Magicienne, and Marathon. The first two are building at Chatham, the Melpomene at Portsmouth, and the two last-named in the shipbuilding yard of the Fairfield Shipbuilding and Engineering Company at Govan, Glasgow. The vessels are similar in dimensions and in their internal arrangements; but the constructive material and engines are different. The Medea and Medusa are being built entirely of steel, and their displacement tonnage will be 2,800 tons. Their engines are placed vertically, with inverted cylinders. In the case of the other three ships, the steel hulls are sheathed with wood and copper to enable them to remain afloat for long periods without having their bottoms "fouled," and their speed consequently reduced. The sheathing, of course, increases the displacement to within a few tons of 3,000 tons, and their speed may consequently be reduced by about ¼ knot to about 19¾ knots. Even in view of this slight loss of speed and the additional first cost which such an arrangement involves, the change of plan is acceptable, as it will give the cruisers an additional advantage over ordinary vessels, rendering them able to lie in coaling or other stations for a long period, and to be afterward available for a speedy voyage to action, without the necessity of entering a dock, in which to have the hull cleaned. With the exceptions indicated the five cruisers are alike.

Of the vessels the Marathon is the furthest advanced, and was the first to be launched from the Fairfield yard, the launch of the Magicienne taking place recently. Like the other ships of the same type, the Marathon is 265 ft. long, 41 ft. beam, and about 24 ft. deep, and the displacement will be between 2,950 and 3,000 tons. She was first built of steel in the usual manner and afterward sheathed with two thicknesses of teak, making together a thickness of 6 in. The inside layer was attached to the steel hull by iron bolts, and the outside one by bolts of gun metal. The bottom of the ship is further covered with sheets of copper nailed to the teak. The ram, stem, stern, and rudder posts, and the brackets for supporting the twin screws by which the ship is propelled, are all cast in solid bronze, these castings together weighing for each ship about 45 tons. The form is similar to those generally used in the construction of government vessels, the stern casting being of course the more intricate. The whole structure is built and strengthened in such a way as to offer the maximum resistance to artillery.

For protection the vessel depends principally on a 2 in. steel deck extending from stem to stern. This deck resembles the back of a turtle, having a declivity at bow and stern and along the sides of the vessel. The top level of this deck—in the center of the ship—is practically level with the water line, and the declination all round makes the connection of the deck with the side of the ship at a point about 5 ft. from the water line. Under this deck are placed the propelling engines and the machinery for working the ship—all the vital parts of the mechanism—as well as the magazines. The coal bunkers are arranged above and below the deck in that part of the vessel where the engines, boilers, etc., are situated, so that additional protection may thus be secured. The vessel has a double bottom on the cellular principle for carrying water ballast. The interior of the hull is divided by bulkheads into ten main water-tight compartments, two of which are occupied by engines, and two others by boilers. These four have no doorways between the spaces, but in some of the other bulkheads there have been fitted doors workable either at the door or from the top deck. In addition, these main compartments are subdivided, especially above the protective deck, there being in all close on 270 water-tight spaces.

The machinery for the Magicienne and Marathon—the vessels building at Fairfield—has been constructed by Messrs. R. & W. Hawthorn, Leslie & Co., Limited, St. Peter's Works, Newcastle-on-Tyne. The engines for each of the cruisers are of the twin screw horizontal surface condensing type, each engine being placed in a separate water-tight compartment. The diameters of the cylinders are: High pressure, 34½ in.; intermediate, 51 in.; and low pressure, 76½ in.; the stroke of piston being 36 in. The engines are designed to run at 150 revolutions per minute, and the horse power to be indicated is 9,000. The total condensing surface is 11,850 square feet. The air pumps are driven from the pistons of the main engine. Separate feed engines, both main and auxiliary, are provided for feeding the boilers. There are also separate bilge and fan engines, feed heaters, distillers of the latest double distilling type, and separate surface condenser with its air and circulating pump adapted for condensing all the steam from the auxiliary engines throughout the ship, including the steering engines, dynamos for supplying the electricity to light the ship, air compressors, capstans, windlasses, etc. Steam is supplied to the main and all auxiliary engines in each ship from four double-ended cylindrical boilers, two in each of the compartments set apart for them. These boilers have in all twenty-four corrugated furnaces, with a grate surface of 456 square feet and a heating surface of 14,070 square feet. They are constructed to work to a pressure of 155 lb. per square inch. There are four stokeholds, which are arranged for working under forced draught on the "closed stokehold system" now universal in the navy. The air is supplied to the furnaces when under forced draught by eight double-sided fans driven direct by high-speed engines. The machinery throughout is of the lightest possible scantlings consistent with due strength to withstand the strains which come upon it when under forced draught and full speed. The shafting is entirely of steel and is hollow, all rods are of the best mild steel, and the bed plates, piston, piston valves, cylinder covers, and most of the valve gear are of cast steel. The stern tubes and propellers are of gun metal. The framework of the rudder is of solid bronze, sheathed with thick gun metal plates, and filled in solid with pitch pine. Particular care has been taken to provide against the steering gear being incapacitated. The rudder, which is on the balance principle now adopted in many war ships, can be worked by hand or steam gear placed under the protective deck, or from the bridge or pilot tower.

The armament of the ship consists of six 6 in. (5 ton) breechloading rifle guns, on central pivot Vavasseur mountings,-two placed forward, two aft, and one each on starboard and port side amidships; ten 6-pounder quick-firing guns, three light guns under 15 cwt., and several machine guns. Six torpedo tubes are to be fitted on board, all under cover, one forward, another aft, and two on each broadside.

Accommodation has been provided for a crew of about 300 men all told. The officers are accommodated under the poop aft, and the "tars" forward. There are the usual cabins, ward, gun, and mess rooms. The external appearance of the vessel will be smart. She has two funnels and two masts. These will only have fore and aft steadying sails, the vessels being solely dependent upon their steam power and twin screws to drive them along at a high speed of 19¾ or 20 knots. The military tops are to be dispensed with in these vessels. This many will regard as a step in the right direction, as the "crow's nest" has been looked upon often as the most likely spot at which the enemy would aim.

The estimated cost of the hull of each of these vessels, as given in the navy estimates, is 64,790*l.*, of the machinery at 50,824*l.*, while the total cost, including gun mountings, torpedo gear, and stores, is calculated to be 136,752*l.* The vessels were designed under the supervision of Mr. W. H. White, Director of Naval Construction. They were commenced in August last year, and those building at Fairfield are expected to be completed in November next, so that the time occupied in their construction will be between fifteen and sixteen months. This, however, must not be regarded as the "record" of the Fairfield Company in speedy shipbuilding. One of the principals in the yard is reported to have said when interviewed by a representative of a London shipping journal: "With our resources in this yard we could turn out a war vessel in three months from date of order if necessary, and there are other builders that could do nearly the same."—*Engineering.*

MONTRICHARD'S VALVELESS PUMP.

MR. MONTRICHARD, inspector of forests at Montmedy, has devised an ingenious pump in which valves are done away with, while at the same time the alternating motion of the piston and the rotary motion for driving are preserved.

The piston, which constitutes the original part of the device, has a helicoidal form (Fig. 1). It is fixed upon an axle, which, running in stuffing boxes, passes through a cylindrical pump chamber closed at both ends. Two rollers enter this chamber at right angles with the axle and bear against the oblique faces of the piston. It results from this that if the latter is revolved by means of a hand wheel fixed upon the axle, a backward and forward motion will at the same time be given which will have the effect of producing on each side a suction and compression. Two tubulures are placed upon the pump chamber at a slight distance from the rollers (Fig. 2). If we examine the operation of the piston, we see that, when it is at one end of its travel, the tubulures are partially covered by it, and if they are sufficiently wide, they communicate with each other on the same side of the piston. But in measure as the latter moves away from the extreme points, the tubulures are separated and become independent. There is then a compression on the side toward which the piston is moving and a suction on the other, and that, too, indefinitely. So long as the direction of rotation

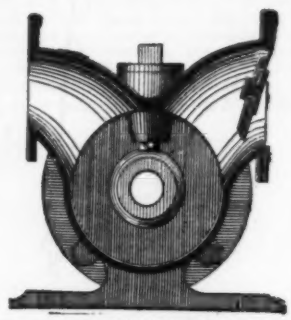


FIG. 2.—TRANSVERSE SECTION.

does not change, the flow of the liquid will take place in the same direction. The resultant of the two combined rotary and to and fro motions is a curve bordering upon an ellipse.

If the rotary velocity is uniform, the velocity of the to and fro motion is null at each end of the travel, gradually accelerating up to the center, and then slackening up. The current follows this motion, and if the tubulures are sufficiently wide, it does not stop, but continues by virtue of the velocity acquired while the piston is crossing the dead point.

It will be remarked that the current may flow in one way or the other, according to the direction of rotation. This property is utilized when the pump is mounted upon a reservoir like a watering cask, for filling it by turning in one direction and emptying it by turning in the other.

Among the small sizes designed for watering gardens, one of them discharges two quarts per revolution and can be maneuvered by one man. It may be used as a fire pump when maneuvered by two men. With 30 feet of hose a height of 60 or more feet can be reached, and this will suffice in most cases. The same model, designed for breweries, is provided with pulleys to be actuated by a motor, and discharges 1,900 gallons per hour at a velocity of two revolutions per second.

The large sizes are provided with air chambers (Fig. 3), which make the liquid flow very smoothly, whatever be the velocity. These chambers are supplied by a channel formed under a screw plug that surmounts the suction chamber. In the large sizes, the priming is done by filling the pump and closing the check valve upon the suction tubulure (Fig. 2), in order to prevent the backflow that tends to occur at the moment the tubulures are in direct communication. The pump

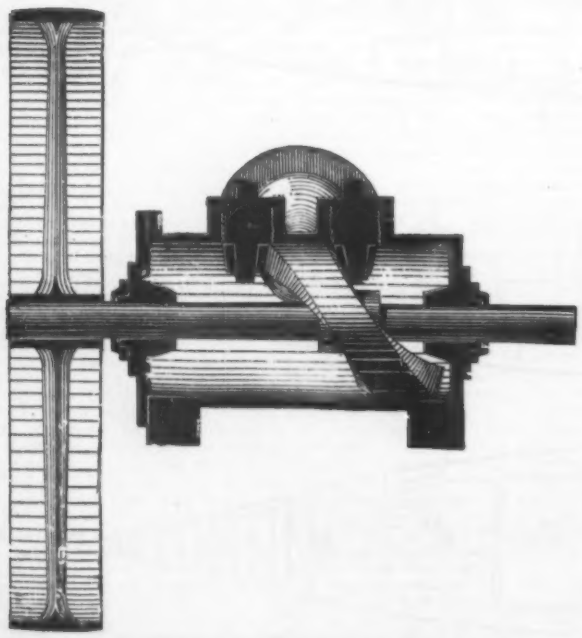


FIG. 1.—PISTON OF MONTRICHARD'S PUMP.

FIG. 3.—MONTRICHARD'S VALVELESS PUMP.

once primed does not get empty again, and remains always ready to operate.

These pumps may be used for pumping water charged with solid substances. The peculiar form of the piston has the effect of bringing all solid bodies into the current, and experience has proved that these generally make their exit intact, although the apparatus is strong enough to crush any obstacles that might oppose themselves to its running.—*Le Genie Civil.*

RAILWAY SURVEYS—CAMP AND FIELD LIFE ON THE UNION PACIFIC.

By C. H. MIDDLETON, C.E.

As I am many miles from my books, maps and drawings, and the only interesting engineering works I have recently seen are those of nature, it has occurred to me that, in lieu of something more scientific, an account of the way in which railroad surveys are made in this country might be of interest to many of the club who have never had to "rough it."

The Union Pacific Railway is the pioneer, and to-day makes more locations, explorations, and examinations into undeveloped parts of the country than any of the other Pacific companies, and its methods are fairly typical of the others.

The growth of business in newly settled parts of the West is so rapid that it offers quite an inducement to the railroads, and a lively competition for the control of those districts among the railroads near them is sure to follow. This creates a demand for, and gives employment to, a large number of engineers.

As a rule, the engineers who have acquired all their experience in the West do not have the great variety of experience in construction which most of their Eastern brethren are favored with, but in "location" and reconnaissance the Western engineer is most favored. The Union Pacific Railroad Company has some old men who have spent all their time at this kind of work. Some of them have been engaged in similar work in Mexico and Peru. These older heads guide and direct those of less experience, with very good results. In this country, where so many hundreds of miles of railroads are built annually, it is of prime importance that the best and most economical location be had, and it is secured here with less time and expense than in the East.

The engineer who makes a specialty of railroad location and construction has a very favorable field in the West, while in the East it is becoming smaller and less profitable every year. In a prairie country, like Kansas and Nebraska, where it costs very little per mile to construct a railroad, and where the demand for them is always urgent, a number of locating parties are constantly in the field.

The party live in tents all the year round, and are furnished with two teams with which to move camp and haul supplies. Usually there are fourteen men in a party, including a cook and two teamsters. When the topography of the country is such as to require contours to be taken on the preliminary lines, two more men are furnished the topographer. Three tents, 14×16 feet, are furnished, as well as all other camp equipment. The members of the party merely provide their own blankets for bedding.

The "office tent," is furnished with drafting tables, stationary chest, and all supplies necessary to make finished maps and profiles of the work. The engineer in charge of the party and transitman, levelman, topographer, and rodman occupy this tent. A small wrought iron stove of the Franklin pattern, without any grate, gives ample heat, and if the party manages to carry their lamp without getting it broken they have a good light.

The "mess tent," when presided over by a good cook, is always sure of unwavering popularity. The railroad company provides everything that is necessary to prepare the food, and they give the engineer in charge of the party full and entire discretion as to what to provide the cook with.

The parties all live well and even enjoy a great many delicacies. Of course there are times when the supplies do not come in on time, and sometimes the cook stove will not draw, and there are many little accidents that will now and then conspire to spoil a good dinner, but in general the mess tent is sure to contain comfort and good cheer, no matter how gloomy the remaining part of the camp is. The remaining tent is used by the rank and file of the party as parlor, sitting room, gymnasium, and dormitory combined. This is always an interesting place, and one that is not affected by anything external. The inmates of this tent are never troubled by the fluctuation of stocks or the war clouds that threaten the destruction of a nation. They are of all ages, from all parts of the country, represent all temperaments and all conditions of servitude. Vital questions of religion, science, politics, and business are discussed with astonishing freedom.

In the winter, when the party is working where there is no shelter, a tent is provided for the horses. One team is usually kept with the party, taking them to and from camp, and, when practicable, moving the transitman from one point to the next. When the party is making ten miles a day, this assists very materially. All the stakes for the day's running, the dinner, and sometimes coats that are not needed on the work, are carried by this team. The other team is kept busy as soon as the party begins to get away from their base of supplies. At one time last winter, when the roads were bad on account of snow drifts, we had to send forty miles for supplies. Once every week we had to send map and profile and a report of the week's work to the chief engineer's office; the team was sent with that and for our mail; then there was fuel to haul, and sometimes we had to haul water. Between times, when there was no hauling to do, they were kept busy scouring the country in search of milk, eggs, poultry, etc.

At one time in the spring, after the snow was gone and we no longer had any to melt, we had to haul all the water we used ten miles over hilly roads. It was in an unsettled country where there were no wells or springs, and the nearest stream, Platte River, was ten miles away.

I spent all of last winter in camp, with nothing but a 12-ounce canvas tent for shelter at night and on days when we could not work. There were six other parties out in the fall, but some were called in by the latter part of November, and only three others were in the field all winter. A number of the engineers have been living in tents continuously for years.

In the mountains all surveys have to be discontinued between November and May, on account of the snow. During that time some of the parties are given work in the prairie country, and some are happy to be disbanded until work is resumed.

I was on location most of the time during the winter, and the line was ninety miles in length. The maximum curvature was three degrees and maximum grade one-half of one per cent. In two places there were five miles of continuous maximum grade. On curves the grade was equated five one-hundredths of a foot per degree of curvature, and all curves of less radius than 5,730 feet were spiraled or elasticized. This equation of grades seems trifling on the line above mentioned, but on other work where six degree curves are used it is important, as every good engineer knows. The spiraling of curves is done by running the curve on an offset and at each end of the curve, and on the adjacent tangent new offsets are made every 25 feet, fixing the line of the spiral.

The length of spiral on the curve and tangent is made equal, and at the point of curvature and tangent the spiral is midway between the original point and the offset from which the curve was run. The length of spiral and the offsets vary for different curves, and for the same curve where the topography of the country requires a light or heavy spiral.

It is the prevailing opinion among Eastern engineers that the work in the West is done in a very loose and slipshod manner, but in justice to all whom I have been associated with in this country, I can say that I have seen more care exercised to insure accurate field work than I ever did in my seven years' experience with the largest railroad company in the East. Although we sometimes run ten and twelve miles a day in favorable prairie country, it is never done at a sacrifice of accuracy. All distances are measured twice, and double sights taken with the transit at every "set up;" that is, after taking a back sight and setting the point ahead, the instrument is turned half way around, a new back sight taken, and another point set ahead; if it does not coincide with the point first set, one is established midway between them to run ahead from. This insures a straight line in case the cross hairs are slightly out of adjustment. Any chance of error from parallax is diminished by reversing the direction of the instrument at each set-up.

In all estimates the prismoidal formulæ are used, and it is not considered accurate enough to average end areas and multiply by the distance between them for the cubic contents.

Last winter was a mild one, and there were but few days when we could not work out doors. I hardly think that Philadelphians would see anything very mild about it, but in Nebraska they judge by a colder standard. From November to March we had snow, and the thermometer most of the time was below zero. On several mornings the thermometer in my tent was 20 degrees below, and outside of the tent it was too low for the thermometer to record. When the wind blew, as it generally does in Nebraska, we could not work when the temperature was 10 degrees below zero, but on calm, still days we could stand it on the coldest days. We had but two genuine blizzards. One of them lasted three days, and it was with difficulty that we kept our tents from being blown away. You may realize that we were very much concerned in the matter when I say that we were miles from any other shelter, and the same storm blew down a number of buildings. In the night we would sometimes have to go out and strengthen the ropes or put in more spikes to hold them. We had the mess tent blown down and badly torn one Sunday, just in time to spoil a good dinner, and kept us busy the balance of the day in repairing the wreck.

When we had good country to work in and not too much snow to wade through, we ran from two to four miles of location per day. That would necessitate our moving camp about once a week. In winter, when the snow is deep, moving camp is the most unpleasant thing to do. If a long move has to be made and the roads are bad, the loads have to be made up and started early, in order that they may reach the next camping place and have tents pitched by night.

On moving days we usually had to turn out at half-past four and pack up and load everything on the two wagons, except the mess tent, before breakfast. The party would then go out to work, and the cook and teamsters afterward finished loading, and would try to reach the new camping place, and clear off some snow and get up one or more tents by the time the party came in from work in the evening. In the summer, when the party is running from five to ten miles per day, the moving day comes oftener.

I known of one party, on preliminary work in the Platte River Valley, that averaged ten miles of line per day, all one summer. When it did not take too much time to get connections with the section lines, they moved camp every day, and sometimes only every other day. Under such conditions a man would be apt to question whether life were worth living.

When we are in a farming district where corn is cheap and coal would have to be hauled a long distance, it is much cheaper to use corn (on the cob) for fuel. Most of the time last winter we used corn for that reason. It cost from sixteen to twenty-two cents per bushel, and coal was worth just twice as much. It burns readily and makes a hot fire. We seldom had any trouble to heat our tents even in the coldest weather. A tent will doubtless seem like very poor shelter, but after lying out with nothing but blankets for a covering, as we had to do many a night, we have learned to appreciate it.

One of the trying things peculiar to the West which we have to do is to get connection with all the section lines and corners near our surveys. These corners have been established by all kinds of methods except the proper one, and it is rarely that we find them as they should be. They were originally put in by contract, and if the contracts were not awarded to the lowest bidder, they surely must have been given to the most incompetent ones. It was a poor policy which led to this false economy on the part of the government, and it has cost the people interested in it more than would have been required to do it properly at first. The trouble which is experienced by the railroad companies arises from the fact that the sections are recorded at the surveyor-general's office as being established accurately, just as the contractors were paid for doing it. Now, in order to hold a location and for government information, our maps, reduced to a scale of 2,000 feet per inch, showing all townships and sections, etc., have to be filed with the government at Washington. These connections are shown just as they occurred on the ground and in a line of 100 miles long. Some places are going to be badly displaced when they plat the line on a section map, which is not as it is on the ground.

This sometimes makes wonderful changes in the geography of the country. I know of one place that is not within five miles of where it is recorded to be in the surveyor-general's office. We found a river recorded as being one mile from where it actually flowed, and it had not changed its channel. A long line seldom passes through all the sections which it would have to in making it fit a government map, and if it goes through them at all, it is not as it really does on the ground. The result of it all is that instead of a line being where it is recorded to be, it is a mile or more away.

The Union Pacific Railway Company have three parties in the Rocky Mountains besides mine, and two parties up in the range on reconnaissance. They also have two parties in the Bitter Root Mountains in Idaho.

I am on the western slope of the "Continental Divide" in Southern Wyoming, and we are running southward to cross the "Divide" near Hantz Peak, at or near the northern line of Colorado.

The gold and silver mines in Northern and Western Colorado, and the coal which is yet undeveloped, are the inducements which led the company to make the surveys. The company now owns and operates a system of narrow gauge railroads in Colorado, which were built in times of mining excitement and before the value of the different fields was determined or even questioned.

All surveys being conducted at present are for broad gauge, and the territory to be developed is undergoing the examination of the company's experts.

The snow on the mountains this far north lasts much longer than it does farther south in Colorado. The parties working down there have not had as much trouble with the snow and water as we have who are in Wyoming. The melting snow floods the streams, so that at times it is impossible to ford them or cross in any other way. The water is cold as ice and runs like the tail race of purgatory. Not many of the streams have bridges, and it is often impossible to get to those that exist. Sometimes a party are cut off from their supplies, just when they need them, by a stream suddenly rising a couple of feet and preventing the return of the teams. Boats are not often to be had, and cannot always be managed when procured. The snow usually thaws during four hours in the middle of the day and then freezes during the night. An unusually warm day or a rain (which is raw) makes a flood, and it is hard to tell when it is coming.

Last month a member of one of the parties who are north of us tried to cross the Platte River in a dugout at a rope ferry. The current was so swift that it swamped the boat and drowned the man, although he held on to the cable which was securely suspended over the stream.

The stream along which I am working is so full of rocks that a boat would be crushed as soon as it was launched. It is too deep and wide to fell trees so as to make a foot bridge, and we cannot cross it at all.

We are running a preliminary line, and no matter how sharp a bend the creek takes, or how inviting the land on the opposite bank, we remain on one side all the way. A location in such a place would have to be made late in the summer or early in the fall.

Most of the snow, below the snow line, is melted by the middle of July, and the streams then become very small.

The men in the mountains on reconnaissance obtain their elevation with the adjusted barometers, which show the equivalent height of a column of mercury to the one-twentieth of an inch, and the corresponding elevation in feet up to 12,000 feet above sea level. We are all furnished with exactly the same instruments, and twice each day note the variation between the correct elevation of camp and that shown by the barometer. When these reports are compiled, and it is found which were local and which general variations, and how the relative elevations affect the variation, it will be of great assistance in determining the allowance to make for the results of the reconnaissance. On May 15 my barometer read 320 feet lower than the correct elevation, and on the 21st, 280 feet above, showing a variation corresponding to 600 feet. This variation was at an elevation of 7,020 feet, and is the greatest that has yet been reported by any of the parties. The greatest variation on one day in my camp is 240 feet, and the least is 25 ft.

When we came into this country on the first of May, we left the railway at Laramie, and just as the church bells were ringing we started out over the "Laramie Plains" with three teams and fifteen men. It is always customary in this country for the party to walk when moving camp, and as we were not novices, we followed the teams, and kept following them for seven days and tramped just 135 miles. It took a week to get in to where we began work on the survey.

On account of the more direct routes being impassable by snow and the streams too high to ford, we had to go southwestward into Colorado and then northwestward back into Wyoming. On the first day we crossed the plains and reached the foothills of Medicine Bow. It was good country for tramping, and we made 30 miles. After that we had mountain roads and hard traveling all the way. Two of the teams gave out in the first three days and had to be replaced with fresh ones. In many places where there was timber the snow along the roads was six feet deep. One team was stuck in a snow bank an hour and had to be shoveled out. There were places where the roads were so steep that all the horses would have to be put on to each load in succession until all were hauled up.

In the valleys there were some bad marshes to go through, and many a time were the wagons stuck fast in mud axle deep. Sometimes the horses would sink into the knees, and then we had to take the load off and get the wagon out before we could put horses to it. In fording some of the streams, the loads had to be lightened and arranged so as to keep the bedding and supplies dry; the horses had to swim.

We made but one attempt to cross the country by a short route. After climbing Independence Mountain, where we were 10,200 feet above sea level, we found the road blocked by snow, so that we had to turn back and go down 1,200 feet to the road that went around the long way.

While on the move we did not pitch the whole camp every night, but merely the mess tent and what was necessary for the cook. After supper we would pick out a place where the rocks were fewest and roll our beds out. Some one would have a big camp fire started by that time, and the musicians of the party would enliven our spirits with the violin and banjo, and sometimes the flute. One by one we would leave the fire and roll up in our blankets, and the trials of the day were soon forgotten. A couple of inches of snow fell one night while on the move, but we had an extra tent up and were ready for it.

Not long after getting in here the "mountain fever" began its work on the party, and at one time five of the men were down with it. Three of them left and two others had to be sent to the Union Pacific hospitals. Two more are now sick and not able to be out.

The company has three hospitals, at Omaha, Denver, and Ogden, which are supported by an assessment of 25 cents per month on all employes. Treatment at the hospital, or by any of the company's physicians along their lines, is furnished gratis to employes. When a man is sent to hospital his pay is continued for one week, but he is kept there under treatment without any charges whatever until cured. In cases where an employe cannot get treatment and medicine from a company physician, or get to a hospital, the cost of treatment is paid for from the hospital fund.

We are now encamped in a canon where there is just width of bottom land sufficient for a tent. In front of the tents the Encampment Creek rushes over the rocks, making as much noise and fuss as the Atlantic Ocean. Just back of us the granite wall runs up hundreds of feet nearly vertical, and then slopes gradually to a height of 1,000 feet above the creek. There is no road near us, and we have to move our camp with pack mules, and get our supplies in the same way.

I had to send down into Colorado, 100 miles, to get as many mules as we need to pack our camp with. We have 16 mules, burros, mustangs, and broncbos, and two experienced men drive and care for all of them. Each animal is provided with a pack saddle, and when properly loaded can carry 300 pounds over a very steep trail. Our cook stove and some other things have to be taken apart to load on the saddles. The tent poles and mess chest and table have to be abandoned and temporary ones made at each new camping place. Moving camp with a train of pack mules involves the party in a number of risks, inconveniences, denials, and sometimes considerable labor. With no road or trail to follow, and with endless rocks, underbrush, and trees to avoid, the mule and its load are liable to an occasional accident. All these things, however, are taken as a matter incidental to the work, and are not of as much annoyance as they may seem to engineers who are not familiar with them.

There is much to look after in addition to the engineering work, and it is entirely new to an Eastern man, but he gradually becomes familiar with the new duties and finds quite a variety of demands on his resources.—*Proc. Engineers' Club of Philadelphia.*

PONTOON AND FLOATING DOCKS.*

IN this paper, any floating structure having open ends, and sides of equal and uniform section throughout, by which ships are lifted out of the water, will be called a "floating dock," but structures having sides varying in height and of less displacement than the bottom tanks will be called "pontoon docks." The sides are supposed to commence at and rise above the deck. The deck is the platform on which the keel blocks rest.

In designing an open-ended floating or pontoon dock to lift a ship of given maximum size and weight it is necessary: (1) For the under deck displacement of the dock to be greater than the combined weight of ship and dock; (2) the dock should be sufficiently strong not only to support the intended maximum ship, but so strong that it will not be injured if the ship has been built or damaged in such a way that a great part of the ship's weight rests either amidships or at the ends; (3) the sides should be made as low and narrow as efficiency will permit, so that a wide working platform may be secured and light and air have access to the ship, and that the top weight and displacement be a minimum; (4) the water should only have a limited cross range in the tanks; (5) if the dock is emptied by pumps, the pumps should be close to the bottom of the dock, so that the water may, as far as possible, run into the pumps without having to be drawn in.

The pontoon built under the writer's letters patent for the Tyne Pontoons and Dry Docks Company, Limited, Wallsend, fairly fulfills the above conditions. Fig. 1 is a longitudinal view of the pontoon, Fig. 2 is a plan, Fig. 3 is a half midship section and half cross section through sill, showing the keel blocks supported on three longitudinal girders, G, F, and G^1.

These girders are stiffened by intercostal plates, A, on every third frame. Stanchions are fitted to the intermediate frames. The frames throughout are 31 in. from center to center. The transverse gusset plates in tank, C, are on every third frame, but in tanks, D and E, are only on every sixth frame. The frames between the gusset plates are fitted with stanchions. The longitudinal water tight girders are shown by F, G, H, I, and K. Three transverse bulkheads divide the pontoon tanks into four longitudinal parts, as shown on the plan (Fig. 2), forming altogether twenty-eight separate tanks.

The plan also shows that the main tanks terminate some distance within the ends and sides of the pontoon. This arrangement permits of an all-round internal examination and free communication between the two engine rooms when the pontoon is sunk. The outside shell plates, up to and a little above the tank top, are $\frac{7}{16}$ in. thick. They and the tank top plates are double riveted in seams and butts throughout.

Two centrifugal pumps, engines, and boilers are placed in the forward end. The pumps are placed, and draw from the main cross drain, M (Fig. 2), which forms part of the structure, and is in communication with the various tanks adjoining. The pumps appear to be well placed, for they have pumped freely.

There is a sluice valve in the cross drain in the longitudinal center line, so that usually the port pump only pumps from the port tanks and the starboard pump from the starboard tanks. Before sinking the dock the distributing valves shown on Fig. 2 are opened, and remain open until the dock is completely raised again. In fact, it would be better not to have these distributing valves, but to draw direct from the end of each tank, and thus each longitudinal set of tanks would be entirely independent of its neighbors.

The water coming in or going out is entirely controlled by the admission or exclusion of air from the various tanks; *i. e.*, if in lifting the dock it was considered necessary to keep the water in any particular tank, the air pipe for that tank would be kept shut, and this gives the necessary control over the water.

The pumps are run full speed during the lifting of a ship, and the man in charge is on the dock or ship, and controls the air pipes, as above described. There are two donkey pumps and a range of piping, by which the tanks can be drained or the dock washed or ships supplied with water to test tanks, fill boilers, etc.

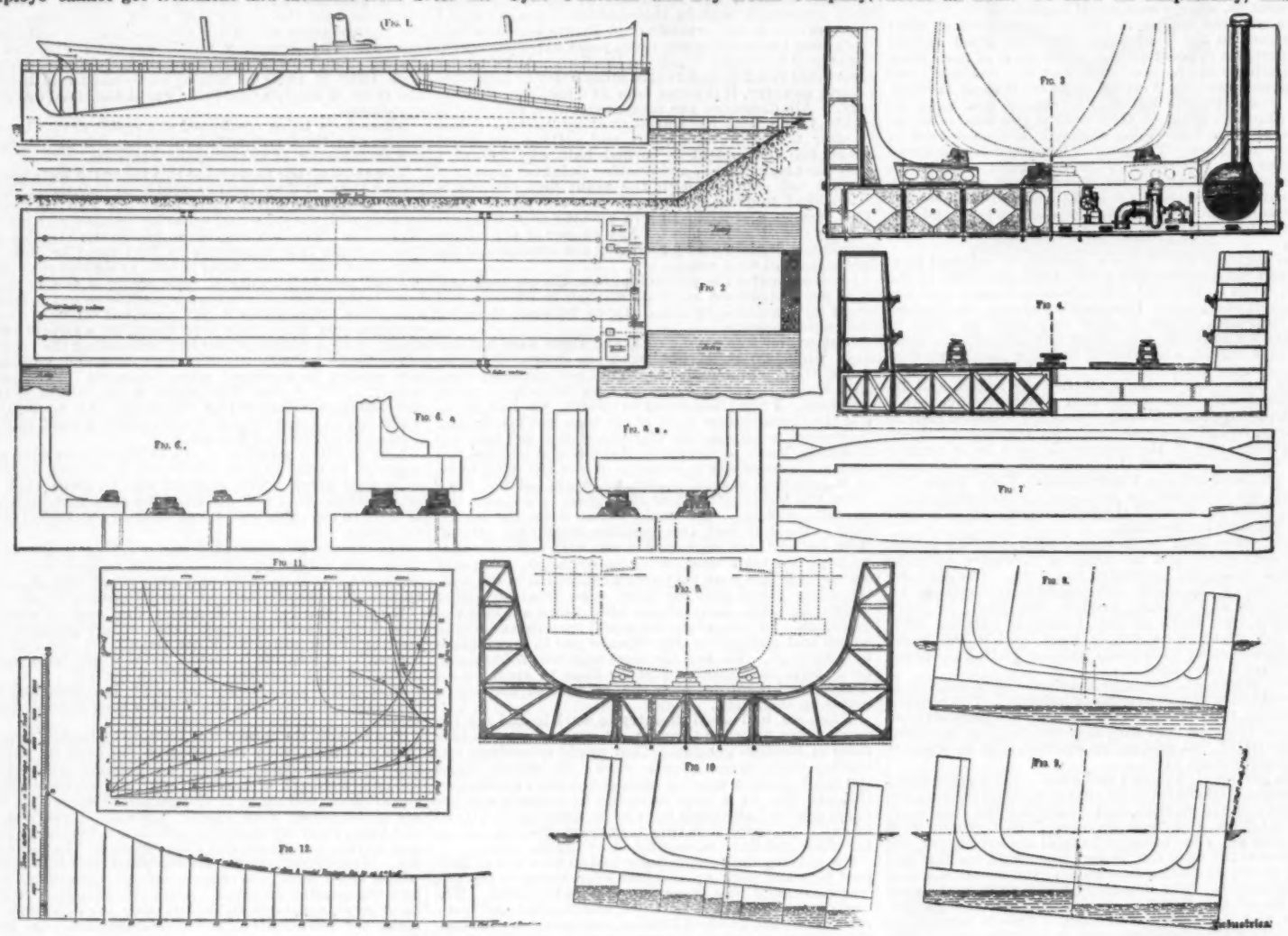
The pontoon was successfully launched, broadside on, in a nearly finished condition, into a space little wider than twice its breadth. The launching ways were an arc of a circle. A ship was docked and lifted within a week after the launch. It has been in constant use for three years, and has lifted 170 steamers in that time. The largest ship lifted measured 300 ft. long, 37·3 ft. beam, and 27·3 ft. depth of hold to upper deck; the ship overhung the pontoon 25 ft. at one end and 15 ft. at the other.

A ship carrying 100 tons can be lifted and sighted in about an hour. To show its adaptability, and the ease with which it can be worked, it may be stated that a steamer was undocked and the pontoon lifted, and all the keel blocks moved and set in two rows to suit a center ladder steam hopper dredger, and again sunk and the dredger lifted, all in one tide. The pontoon is lighted by gas throughout.

Some such reasoning as the following led to the sides being made in form as shown by Fig. 1. A ship to be moved into a dry dock or on to a slip must have sufficient stability in herself, or ballast must be added to give the necessary stability before she can be moved; therefore, in this condition she requires no external aid.

A pontoon when sunk, ready to receive a ship, must in virtue of its construction have the combined center of gravity of the structure and contained water some distance below its center of buoyancy, and consequently it must remain upright even if totally submerged. Now, as it has been shown that the ship must be stable, and the pontoon has enormous stability, it is evident the pontoon requires no sides above the water to give it stability at the time when it and the ship are combined; but while the water is being pumped out of the pontoon, the combined center of gravity of the ship, pontoon, and its contained water will rise, and the combined center of buoyancy will fall; and, therefore, the dock must have sides to give stability as it rises, until ultimately the sides are made the full length, and the maximum stability is secured with a minimum of top weight and displacement. The sides, being low, allow light and air free access to the ship, and the ship's bottom is thus easily seen and rapidly dried.

Fig. 4 is a cross section of the Rotterdam harbor authorities' two floating docks. They have been in use about four and a half years, the work upon them is



PONTOON AND FLOATING DOCKS.

*Paper read by Mr. Alexander Taylor, before the North-east Coast Institution of Engineers and Shipbuilders, April 11, 1888.—*Industries.*

excellent, and I believe the docks are strong. Fig. 5 is a cross section of a dock built or building by the Dutch government for the East Indies. It appears to be exceptionally strong. Figs. 6 and 7 show a design the writer proposes to employ for making a self-docking pontoon where desirable. It will be noticed that the center part can be taken out and lifted by the two side pieces, as shown on Fig. 6, *b*, or one side can be lifted by the center and one side piece, as on Fig. 6, *a*.

This plan has many advantages, the longitudinal strength of a solid dock is maintained, and its cross strength is easily provided for. The design is convenient for transport, or for placing in ordinary dry or wet docks. The writer is quite sure the connections of the three parts can be arranged to be thrown adrift, and one part lifted by the other two in one tide. It would be interesting to compare in detail these docks, both in strength and stability, but this of course cannot be done here.

The lifting power of the various docks may be taken to vary roughly as the under deck displacement. Sir Frederick Bramwell, in his paper on "Floating Docks," read before the Institution of Mechanical Engineers in 1867, pointed out that their stability varied as the square of the number of tanks in the cross section of the dock. If this is true, then all floating docks should be built with numerous water tight longitudinal bulkheads, so that the water may have comparatively little transverse motion. Figs. 8, 9, and 10 illustrate the above.

Fig. 8 shows a dock and ship listed to 5°. The water is allowed to travel from side to side. The positions of the center of gravity and center of buoyancy show the dock to be unstable, and that it will go further over before coming to rest. The same applies to Fig. 9, only in a less degree, as the water can only travel between the center and the side.

Fig. 10 shows the dock and center of buoyancy in the same position as Figs. 8 and 9, but the center of gravity is on the stable side, and if any internal or external force was able to list the dock so far over, it would right itself.

The relative initial stability of the three docks exclusive of the ship's stability, and purely because of their internal construction, would therefore be 1, 14, and 49. In 1869, Mr. G. B. Rennie read a paper before the Institution of Naval Architects, in which he describes the Carthagena floating dock, and gave its righting moment at 10° list when the dock is out of the water, and at the same time supporting a Spanish war vessel.

This, of course, is a most stable condition for the dock when supporting the steamer. As far as the writer can learn from the paper, he does not take into account the effect of the contained water traveling over as the dock lists.

The diagram he gives is purely one point in the metacentric diagram. This seems to be the usual way of showing a floating dock's stability, but it is, in my opinion, extremely misleading. The metacentric curve for docks is only useful as a means of comparison when the docks are of similar design and uniformly proportioned. I will endeavor to explain this fully from calculations made for a pontoon dock which has not yet been built, so that no one can object to their publication, and it will be called the model pontoon.

Let the displacement curve, D, on Fig. 11, represent the pontoon's displacement curve, M its metacentric curve, and B its center of buoyancy curve. Fig. 11 also shows the displacement, *d*, center of buoyancy curve, *b*, and metacentric curve, *m*, of a deep, narrow, tender proportioned steamer, which is supposed to be the heaviest ship this particular dock will lift. The figure also shows the before mentioned curves combined in M^2 B^2, and also the combined center of gravity curve, G^2, as if the vessel and pontoon were one structure, and to be raised as one.

In making such calculations, it is necessary to be perfectly sure that, if there is an error, it shall be on the safe side, and having this in view, the steamer's center of gravity is supposed to coincide with its light draught metacenter, G, on Diagram 11, and we may take it that the steamer could not be moved into the dock if the center of gravity had been higher. The center of gravity of the pontoon is supposed to coincide with its center of total displacement.

This is also well on the safe side (Mr. G. B. Rennie places the center of gravity of the Carthagena dock one-fourth lower). The center of gravity of the water in the tanks is supposed to remain constantly at half the height of the bottom or under deck tanks. It is possible, under extraordinary circumstances, that the water might remain so high, but it is not possible for it to be higher.

Along with this explanation, it is necessary to say the calculations have been carefully made on the actual form of a ship and the model pontoon, having tanks arranged as shown in Fig. 10.

You will notice the result shown by Fig. 11 is that at a pontoon draught of 23 ft. there is 4½ ft. metacentric height, with the combined center of gravity 18 inches above the combined center of buoyancy. And at a draught of 17¼ ft. we have the least metacentric height, viz., 3¼ ft., when the combined center of gravity is 6 ft. above the combined center of buoyancy. At 11 ft. draught, when only the keel of the ship is in the water, we have 9 ft. metacentric height with the combined center of gravity nearly 12 ft. above the combined center of buoyancy. And at 7 ft. draught we have 33 ft. metacentric height when the combined center of gravity is 14½ ft. above the combined center of buoyancy.

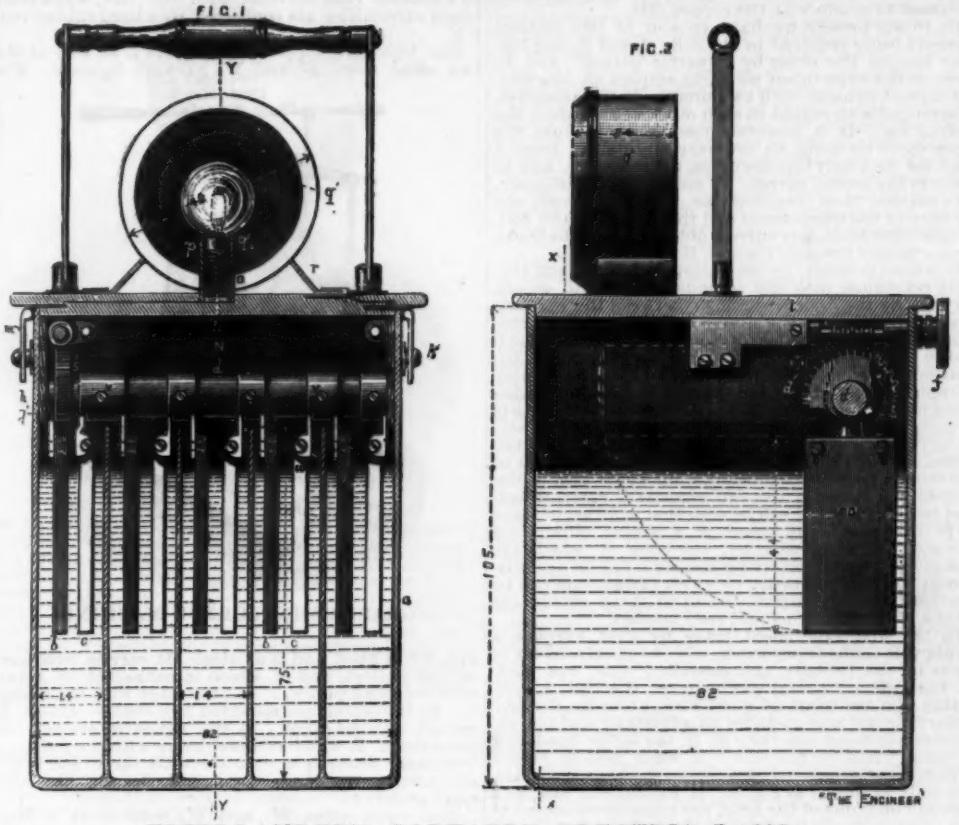
Diagram 12 shows the combined righting moment for the said ship and pontoon at 5° list during the whole process of lifting the vessel, from the time the ship touches the blocks to the time the dock is pumped dry. Where the curve of moments runs into the vertical ordinate at N, representing 7 ft. draught, the righting moment is calculated for the water being over one half the pontoon deck, while the moment M on the same ordinate is calculated for the deck entirely free from water, in which position the dock invariably is when supporting a ship out of water. Of course it must be clearly understood that these diagrams, etc., give the model dock's stability under the most unfavorable conditions possible to conceive.

THE largest chain ever fabricated is in the Imperial Arsenal, Vienna. It has 8,000 links, and was thrown across the Danube in 1529 by the Turks.

A PORTABLE ELECTRIC LAMP.

THE *Annales Industrielles* gives the following description of an electric lamp invented by M. A. Friedlander, of Berlin: This lamp is composed of a rectangular box, *a*, of hardened India rubber, divided within into several cells, which are formed by parallel walls also of India rubber, and moulded with the box. These cells contain the necessary liquid, and are capable of containing the electrode plates of the lamp. The carbon plates, *b*, and the zinc plates, *c*, are united to an axis, *d*, of hardened India rubber, so placed as to lower or raise the plates by turning on its axis; this movement is produced by means of an endless screw, *e*, which is turned with a button, *f*, and which gears with a toothed sector, d^1, fixed on to the axis, *d*; this screw, *e*, rests in a metal support. The extreme plates, one of which is necessarily of carbon and the other of zinc, are shown attached to the screw plates by pivots, and regulate the current of the supports by two small knobs, *k*, which are placed outside the box. At this point, then, the poles + and — of the battery are found. These two knobs, *k*, placed on each side of the box, *a*, which turn eccentrically on their own axis, serve at the same time to fix the cover, *l*, by means of two hinged hooks, *m*, and to establish a communication of current with this same cover. The communication with the lamps is effected by means of a disk of sheet copper attached to the hinge, *m*, from whence the current crosses the spring, *o*, and the disk, *p*, reaches the lamp. After having crossed the frame of the latter, it is conducted through the socket, *g*, to the reflector, and from thence to the foot, *r*, to the sheet of copper, and finally by the other hinge to the other pole of the battery.

The carbon plates are fixed to the metallic rods by means of transverse screws, *t*, while the zinc plates are fitted into a case by the screws, *u*. This disposition has the advantage of rendering it easy to replace the worn-out electrodes. The system of immersion of the electrodes is particularly convenient, as it enables the electrodes to be partially lowered or raised by simply turning the button, *f*, and thus regulating the intensity of the light as in an oil or gas lamp, or it may be extinguished completely.



FRIEDLANDER'S PORTABLE ELECTRIC LAMP.

ELECTRO-DYNAMIC ROTATION BY MEANS OF ALTERNATING CURRENTS.

PROFESSOR GALILEO FERRARIS, of Turin, who, as will be remembered, was one of the first to make a strictly scientific investigation of transformers, and who has since then continued to devote attention to alternating currents, has just published the results of some experiments made with a view to produce continuous rotation by their means. The experiments are interesting, because the apparatus used was based upon an entirely new principle, which may be capable of further development. The question how to produce continuous rotation by means of alternating currents is just now occupying the minds of many electricians, because the production of an alternating current motor would greatly increase the earning capacity of central electric light stations supplying alternating currents. Whether the apparatus devised by Prof. Ferraris, and which we are about to describe, will lead to the discovery of an alternating current motor, is a question on which we do not pretend to prophesy. But as the principle involved may also have other applications, notably in the construction of meters for measuring the supply of electricity, we think it of sufficient importance to lay a short abstract of the investigation before our readers. The principle on which the apparatus is based is exceedingly simple, and will be understood by reference to the accompanying sketches.

Let, in Fig. 1, the lines, O A and O B, represent in direction and magnitude the strength of two magnetic fields. The combined action of these fields on a unit pole, placed in the point, O, would then be represented by the resultant, O R. Instead of having two distinct fields, we have one resultant field, represented in direction and magnitude by this line. If both fields undergo periodic variations of the same period, the resultant field, O R, will also undergo a periodic variation, and the point, R, will traverse a curve, the form of which depends upon the precise manner in which the lines, O A and O B, change with the time. The fields, O A and O B, can be produced by two coils, having the lines, O X and O Y, respectively for their axes, and which coils are traversed by alternating currents of the same period. If the alternating currents may be expressed as sine functions of the time, and if there is an appreciable lag between the currents in the two coils, the point, R, describes an ellipse round O as center. In this case the line, O R, representing the resultant field, revolves round the center, O, the direction and magnitude of the resultant field changing at every instant.

If, however, there is no lag between the two currents, that is to say, if they pass through zero simultaneously, the direction of the resultant field, O R, remains stationary, and the point, R, performs harmonic oscillation over the line, R O, and its prolongation with O as center. This may be considered as a special case of the ellipse where the latter has been flattened down to a mathematical line. Another special case occurs when the ellipse becomes a circle, and this must evidently take place when the lag between the two currents is 90°, when the coils are at right angles to each other, and when the component fields are equally strong. A metallic body suspended in the center of the two fields,

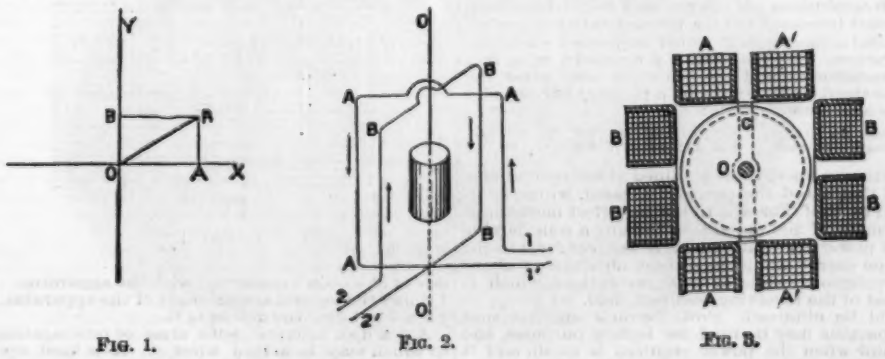


FIG. 1. FIG. 2. FIG. 3.

ELECTRO-DYNAMIC ROTATION.

and free to revolve, must evidently have a tendency to participate in the rotation of the resultant field.

The application of this very simple principle will be clear from Fig. 2, in which the two coils are indicated by the rectangles, A and B, the connections being made by the wires, 1 1^1 and 2 2^1, respectively. When alternating currents are sent through these coils a resultant field is produced, which revolves round the line, O O. In the center between the coils is suspended a small hollow cylinder of copper, and as the lines of the resultant field cut the metal Foucault currents are induced, and by the interaction of these induced currents and the revolving field the cylinder is set in rotation. The action is exactly the reverse of that occurring in the well known experiment in which a copper disk is rapidly revolved below a compass needle, with the result that the compass needle is deflected on account of the induced currents in the copper disk, and ultimately caused to rotate with the copper disk.

Up to the present we have spoken of two distinct currents being required in the coils, A and B, one lagging behind the other by a quarter period. And to perform the experiment we might employ an alternating current dynamo with two circuits in the armature, so arranged, with regard to each other as to produce the desired lag. It is, however, possible to perform the experiment by using an ordinary alternating current machine with only one circuit on the armature, and to produce the second current by means of a transformer. The current from the machine is sent through the primary of the transformer and then through the coil, A, while the secondary current obtained from the transformer is sent through the coil, B.

It is then possible, by the interposition of a suitable inert resistance into the secondary circuit, to obtain very nearly the desired lag of 90° between the currents in the two coils. As the strength of the secondary current will, by the insertion of the resistance, be considerably reduced, it is necessary, in order to obtain approximately equal fields from the two coils, to employ a larger number of turns in the coil, B, than in A. Another method of producing the desired result consists in using a transformer with one primary and two secondary coils, and to insert into the circuit of one of the secondary coils a large self-induction, and into that of the other a large inert resistance, by which means the desired lag between the two secondary currents can also be obtained. It will be seen that in either of these ways it is possible, by means of a simple alternating current and a transformer, the coils of which are abreast, to obtain a revolving magnetic field of approximately uniform intensity, by which phenomena can be produced in every respect similar to those obtainable from a revolving permanent steel magnet.

In the first experiment made by Prof. Ferraris, a Gaulard & Gibbs transformer, with an equal number of turns in the primary and secondary coils, was used. In the primary circuit was included the coil, A, consisting of a few turns of stout wire, while in the secondary circuit were included an adjustable and non-inductive resistance and the coil, B, the latter consisting of many turns of fine wire. A small hollow copper cylinder was suspended on a thread in the center of the two coils, as shown in Fig. 2. If the current was sent through only one of the coils, the cylinder remained at rest; but if currents were sent through both coils, the cylinder immediately started to revolve, twisting the thread on which it was suspended. A reversing switch was inserted in the secondary circuit, and if the current through this circuit was inverted, the cylinder was immediately brought to rest, and started in the opposite direction.

Prof. Ferraris next substituted a small iron cylinder for the copper one, and found equal results. But when using an iron cylinder sufficiently large to nearly fill the place within the coils, the experiment did not succeed so well. He attributes this to the greater self-induction which the presence of iron in a large mass necessarily introduces into both circuits. Another experiment was made with a small iron cylinder, composed of a number of thin disks insulated from each other, and this experiment also succeeded. Foucault currents could not in this case be the cause of rotation, and Prof. Ferraris thinks that the rotation is due to hysteresis. A larger apparatus was then constucted, which is indicated in our sketch, Fig. 3. In this case the copper cylinder, which was mounted upon a horizontal axis in bearings, had a diameter of 3⅛ in., and was 7 in. long, its weight being 11 lb. This cylinder was closely surrounded by the primary and secondary coils wound upon wooden bobbins. To make room for the shaft each coil was in halves, the primary consisting of ninety-six turns of seventy-seven mils. wire, both coupled in series, so as to produce the effect of a coil of 192 turns; the secondary consisting of 504 turns of 38 mils. wire, both being coupled in parallel, so as to produce the effect of 504 turns. The resistance of the primary coils was 7·12 and 6·63 ohms respectively, and that of the two secondary coils coupled in parallel was 3·43 ohms.

In the secondary circuit was also inserted a rheostat without self-induction, and the best results were obtained when the rheostat was set to between 15 and 18 ohms. A Gaulard & Gibbs transformer was used, giving eighty reversals per second. The copper cylinder began to revolve when the primary current was 5 amperes, and with higher currents the velocity could be increased to 900 revolutions per minute, and might have been still further increased but for the somewhat imperfect mechanical arrangements, which occasioned considerable vibrations. To the shaft was applied a small friction dynamometer, and the following table gives the work obtained on the brake by a primary current of 9 amperes at different speeds:

Revolutions per minute....	262	400	546	652	722	770	772	900
Watts obtained on brake....	1·32	2·12	2·65	2·77	2·55	2·40	2·04	0

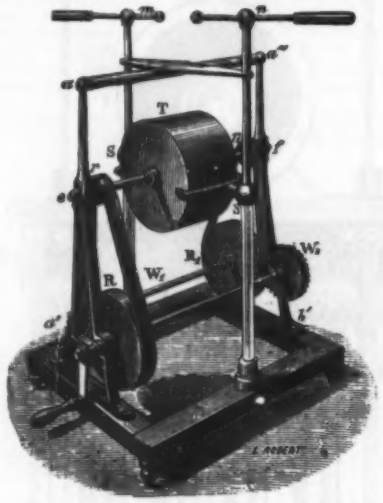
The maximum energy was obtained at 650 revolutions. Beyond that speed the energy decreased, which is attributed by Prof. Ferraris to the imperfect mechanical arrangement of the apparatus, causing a considerable waste of power in vibrations. If it were not for this, the maximum energy would have been obtained at about 1,200 revolutions, while at 2,400 revolutions, which is the speed of the revolving resultant field, no energy at all could be obtained. Prof. Ferraris suggests that this apparatus may be used for lecture purposes, and as a motor when the power required is small, and it may also be used as an electricity meter. The torque exerted by the revolving field upon the copper cylinder is proportional to the square of the current, and in order that the total number of revolutions performed in a given time may be an indication of the number of coulombs supplied, it is necessary to introduce some opposing force which varies with the square of the velocity. If this can be done, and if the friction of the journals can be sufficiently reduced, an ordinary counter attached to the axis would indicate the quantity of electricity supplied.—*Industries.*

A NEW INFLUENCE MACHINE.

MR. GRASER, of Vienna, has constructed a new influence machine of a very interesting form, designed for the purification of atmospheric dust. Its arrangement is shown in the annexed figure.

The iron supports, $a\,a'$ and $b\,b'$, are fixed by screws to a wooden base provided with four feet, while their upper extremities are connected by a hard rubber rod, $a\,b$.

The two bars support the axles, $e\,f$, as well as the two other axles, W and W_2, situated beneath. The



GRASER'S INFLUENCE MACHINE.

axle, $e\,f$, is fixed and is of steel. It carries two hard rubber pulleys, one of which is connected by a belt with the small pulley, r, and the other with the pulley, r_1. In the center are mounted two ebonite drums, T, one set into the other. In the figure we see only the outer drum, T, which communicates with the pulley, r. The inner drum is concentric with the other, but is about 8 mm. smaller. It communicates with the other small pulley, r_1.

The lower axles, W_1 and W_2, both carry a large pulley, R or R_1, and a ratchet wheel. The axle, W_2, likewise carries a winch, M.

The pulleys, r R and r_1 R_1, are provided with belts that permit of revolving the pulleys, r_1 R_1, the axle, W_1, and the external drum, T, in the direction of the winch, and the pulleys, r R, the axle, W_2, and the inner drum in the opposite direction. The wooden base carries likewise two supports, half of glass and half of metal, which terminate in metallic balls, m and n. In the center are metallic balls, S S, each of which carries a comb that surrounds the edges of the external drum, T. The fixed steel axle, $e\,f$, carries within the drum a vertical metallic rod, at each end of which there are combs arranged at right angles with the external ones. The exciters at the lower part are movable in the interior of the balls, m and n.

In order to excite the machine, the two exciters, A_1 A_2, are moved toward each other until their balls touch.

The winch is turned to the right or left, and a piece of hard rubber is rubbed lightly against a piece of cloth that is held near the center of the surface of the drum, T. A slight crackling then shows that the machine is excited.—*La Lumiere Electrique.*

THE ELECTRIC SPIDER.

THE apparatus illustrated herewith is designed to operate an alarm by closing an electric circuit in any place whatever, in case of an attempt to break open a

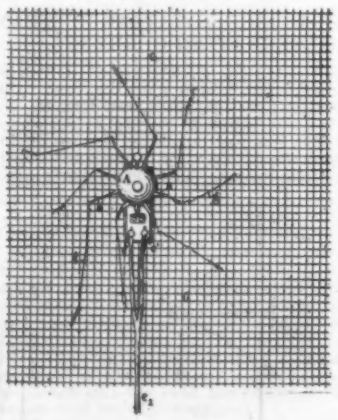
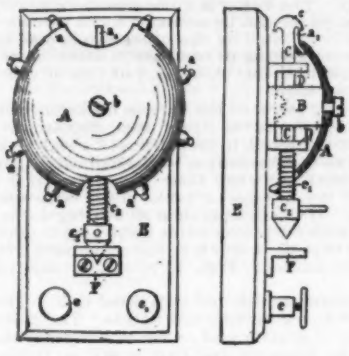


FIG. 1.

safe or any object connected with the apparatus. Fig. 1 shows the general arrangement of the apparatus, and Figs. 2 to 4 give the details of it.

A is a disk provided with arms or prolongations, a, to which may be affixed wires, g. It is fixed upon a support, B, by means of a screw, b, around which it turns freely, and is provided with a prolongation, a_1, against which the head, c, of a metallic bolt, C, bears when the disk, A, is so turned that a_1 is vertical.

The bolt, C, passes into the three apertures of a bridge, D. It is pulled by a spiral spring, c_1, which bears against D and the block, c_2, that terminates the bolt, C. An insulated wire, passing under the base, E, runs from the bridge, D, to a terminal, e. Another wire, starting from the stop, F, which is provided with a conical aperture, runs to the terminal, e_1. Insulated conducting wires, e_2, starting from these terminals, end at a pile and electric bell, that both may be arranged in any properly selected place. The whole internal sur-



FIGS. 2 AND 3.

face of the object to be protected is covered with a net, G, to the center of which the apparatus is affixed.

The arms, a, are connected with different points of the net by means of cords or wires, g, provided with hooks at their extremities, and which may be of different lengths. It is advantageous to arrange the wires or cords in various directions.

The apparatus operates as follows. When the net is touched, or when it is disturbed in any manner, the cord, g, which is in proximity will revolve the disk, A, slightly on its axis.

The prolongation, a_1, then escapes from the head, c, of the bolt, C, which is at once pulled back by the spring, and the extremity, c_2, enters the aperture in the piece, F, thus forming a circuit and starting the alarm. The new arrangements that formed the subject of a request for a patent are the following: An apparatus designed to indicate the breaking open of anything, consisting of a net, G, fixed in the interior of the ob-

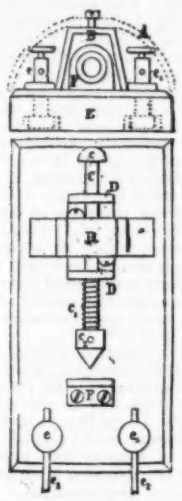


FIG. 4.

ject to be protected, and in the meshes of which end the extremity of cords or wires, g, starting from a very movable disk, A, whose prolongation, a, holds a contact piece, c, which falls back as soon as the net is touched or shaken.

From this there results a closing of an electric circuit which operates an alarm bell.—*Revue Internat. de l'Electricite.*

THEORY OF TELEPHONE CONDUCTORS.

THE chief factors influencing the propagation of the rapidly altering undulations with which we have to do in telephonic currents are the resistance of the line, its self-induction, its capacity, and the leakage to earth or to neighboring wires, to which may be added the polarization of the dielectric; this latter becomes of importance where we have to deal with portions of a line which for any special reason may have to be placed underground.

The good quality of a telephonic transmission is determined by the strength and clearness of the sounds reproduced. By suitable construction of the apparatus it is always possible to insure sufficient strength. In order to transmit speech well, it is necessary that the several notes which go to make up one sound should be reproduced with great clearness, otherwise the sounds get mixed, and mistaken one for another. Now, the four previously mentioned factors influence the clearness of the transmitted words, chiefly on account of their action on the phase of the undulations. Their influence may be summarized thus:

1. The greater the resistance and the leakage, the smaller is the strength of the received current.
2. Self-induction favors high notes.
3. Capacity favors low notes.
4. The resistance diminishes the effect of self-induction and increases the effect of capacity.
5. Leakage diminishes the effect of capacity and increases the effect of self-induction.
6. In a conductor having both self-induction and capacity, the relative intensity of the undulations in-

creases and decreases periodically with the rise in the height of the note.

7. The magnetic permeability and the polarization of the conductor destroy the clearness of the transmission.

It follows that the best possible conductor is one in which resistance, leakage, capacity, and self-induction are each as small as possible. A looped circuit, consisting of a copper wire three mm. in diameter, seems best to fulfill the several conditions. The resistance of such a wire is about five ohms per kilometer, the self-induction is about 0·001, the capacity 0·01 microfarad, and by the use of suitable porcelains the insulation resistance may be brought up to 100 megohms.

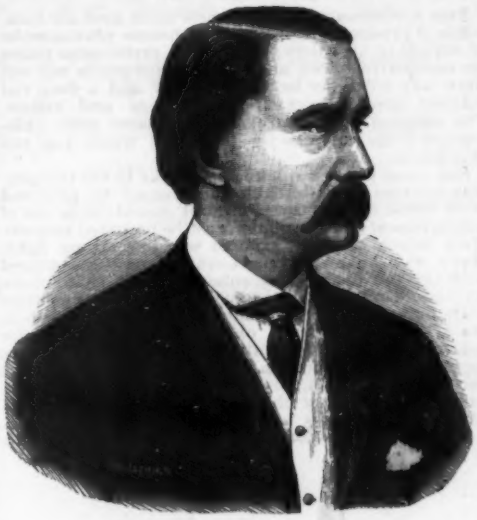
The question naturally arises if it is not possible to counteract the defects of underground wires, the capacity and polarization of which must be made greater than in the case of aerial lines. From the laws 2 and 3 it would appear that improved transmission would result from connecting up a line with much capacity to one with large self-induction. As, however, the capacity can only be altered within narrow limits, and the self-induction only admits of treatment by using iron instead of copper wire, while the leakage may vary, according to the state of the weather, from 10 megohms to 1,000 megohms, such a joining up of lines with different properties cannot be carried out practically. Nor can artificial lines be used with any better result. It is well known that the capacity of condensers and the self-induction of solenoids can compensate each other; but their application to telephone lines only makes matters worse than before.

A glance at the physical meaning of these two quantities will make this clear. The dimensions of self-induction are $[l^{-1}, s^2]$, those of capacity $[l]$, in electrostatic units. The product of the two is therefore the square of the unit of time. The action of self-induction is instantaneous, and the effects are produced simultaneously at every point of the conductor. Consequently, the current is the same in every point at any definite instant. The capacity, on the contrary, acts gradually on the current, so that it is less at the far end of the conductor than at the beginning. Consequently, in a conductor having appreciable capacity, the current is different in every point at any definite instant.

Due attention seems now to be paid to the necessity of reducing the four main disturbing elements to a minimum in building long lines, but in the network of conductors in towns this is not the case. The resistance is often very great, and might be reduced to one third. The capacity of telephone cables is a maximum instead of a minimum. The leakage, which should be as equal as possible, varies from 1 to 1,000. The self-induction of the lines is often unnecessarily increased by the introduction of electromagnets. — *Elektrotechnische Zeitschrift; Elec. Review.*

SIR CHARLES BRIGHT.

WE regret to have to announce the death of Sir Charles Bright, which took place on the 3d of May, at his residence, in London. He was the youngest son of Mr. Brailesford Bright, the principal partner in the firm of Heron, Bright, McCulloch & Co., drysalters, in Bishopsgate street, and head of a well known family in Hallamshire, in the West Riding of Yorkshire. Charles Bright was educated at the Merchant Taylors' School, and very early in life he turned his attention to electricity and chemistry. When a lad of sixteen, he and his two elder brothers joined the service of the Electric Telegraph Company, and Charles, after a short novitiate in the practice room, was sent to Liverpool as junior operating telegraph clerk. Shortly afterward he was transferred to Birmingham, and eventually he joined the British Telegraph Company, under Mr. Highton, while his brother Edward had meanwhile joined the Magnetic Telegraph Company, and the two brothers brought about the fusion of the two companies, under the title of the British and Irish Magnetic and Telegraph Company. This company became a strong competitor with the Electric Telegraph Company, which was incorporated in 1846, with Mr. John Luis Ricardo, M.P., as chairman, and which original company must be regarded as the parent of all the subsequent telegraph companies. Very early in life Charles Bright was intrusted with erecting telegraph stations and lines in the North of England and in Scotland, and on one occasion he achieved the remarkable feat of laying an underground cable in Manchester in a single night, without causing any interruption to the traffic in the streets. Jointly with his brother Edward, he invented and patented many valuable improvements in telegraphic apparatus, but his greatest achievement was in connection with ocean telegraphy. The late Mr. Crampton, by his cable across the Channel, had shown that signals could be transmitted across the sea; but it was reserved to Charles Bright to conceive the gigantic idea of laying a cable under the Atlantic to join the old world with the new. This was after he had successfully laid the first cable which united Great Britain with Ireland in 1853. He had been experimenting for some time on a system of insulating wires with gutta percha, and the success with an experimental circuit 2,600 miles in length led him and others to the conviction that telegraphic communication with America was possible. The idea found at first but little favor with capitalists in New York and Boston, whom Mr. Field tried to interest in the scheme. Mr. Field came over to England in 1856, and entered into an agreement with Mr. Brett, Mr. Whitehouse, and Mr. Charles Bright, who at that time was the engineer of the Magnetic Telegraph Company. Under this agreement, each of these promoters was mutually bound to push on the undertaking in every possible way, and to share in the ultimate profits to be derived therefrom. Charles Bright and his friends raised the capital necessary for the first Atlantic cable, which was successfully laid by him in 1858, he being then the engineer in chief to the company. He designed the paying-out machinery, and the other mechanical appliances required for the submergence of the cable, and associated with him were Sir Samuel Canning, Mr. H. Woodhouse, Mr. H. Clifford, Mr. F. C. Webb, and Sir William Thomson. The two thousand miles of cable required were made in England, and in the laying there were employed four ships lent by the British and the United States governments. After the great services thus rendered to ocean telegraphy, Mr. Bright was knighted by the lord-lieutenant of Ireland. Sir Charles Bright was next engaged in submarine telegraphy in the Mediterranean and the Baltic, after which he was summoned in 1864 by the government of India to complete the telegraphic communication with Europe, which work he accomplished by joining Kurrachee with the northern end of the Persian Gulf. He subsequently superintended the laying of cables between the United States and Cuba, and was also engaged in the erection of telegraph lines between various parts of North and South America. Sir Charles Bright was elected a member of Parliament for Greenwich in 1865, and represented that constituency for several years in the Liberal interest. In 1881 he was appointed by the Foreign Office one of the commissioners to represent Great Britain at the Electrical Exhibition at Paris, and he



SIR CHARLES BRIGHT.

was afterward nominated by the French government an officer of the Legion of Honor. In 1865 he contributed a very important paper to the Institution of Civil Engineers, in which he advocated submarine telegraphy to China and to Australia, and which paper received a Telford medal and premium. He was a member of the Institution of Civil Engineers, the Society of Telegraph Engineers and Electricians, of which he was the president last year, and he was also a member or fellow of several other learned societies.— *Industries.*

GENERAL BOULANGER.

GENERAL BOULANGER, the deputy of the Department du Nord, is to-day the most talked-of man in France. Called from the command of the division of the army in Tunis to the head of war department, he was a member of the cabinet formed by De Freycinet, January 7, 1886, and was carried on into the Goblet cabinet, which held office from December 11, 1886, to May 30, 1887. He afterward had command of the 13th army corps in Clermont-Ferrand, from which he was removed in March, 1888. He was court-martialed, and finally pensioned and his name removed from the army list by order of President Carnot. As to his early life, we will state that he was born in 1837. In 1856 he became under-lieutenant in the Turkish army. He was wounded in the Italian war and received the cross of the Legion of Honor. He joined an expedition to Cochin-China as first-lieutenant, and then acted as instructor in the school at St. Cyr until the war of 1870. While serving as colonel of the 114th infantry regiment in 1871, he was severely wounded at Bapaume. In 1880 he was made brigadier-general, and afterward went to the United States to represent France on the occasion of one of their anniversaries.

It might be supposed that such an active military career would bind one who had survived it to the army, and that he would find his greatest satisfaction in his vocation as a soldier, gladly renouncing all political laurels, but Boulanger's ambition aimed higher. He considered the department of war only a stepping stone to the dictatorship, and stood ready to accomplish his ends on the fall of the Goblet cabinet, but Rouvier and Grevy succeeded in warding off the danger which threatened France. It was thought that by the transfer of the command of the 13th army corps the ambitious general would be rendered harmless, but this hope was groundless, for Boulanger had become too familiar with the idea of attaining the highest power to give it up because of a single defeat. He simply altered his plans and sought to reach his goal indirectly through the office of deputy. He aimed at nothing less than being called to the presidential chair by a sort of *plebiscit.* As early as 1887 he allowed himself to be put up in Paris as a candidate for election as a substitute for the chamber of deputies, although he was not eligible, and continued these tactics at the elections of January 26, March 25, and April 15, until he was elected by a large majority in the Department du Nord, having in the meantime become eligible.

After this success his arrogance knew no bounds. He entered the chamber of deputies as the man to whom the future of France belonged, and his adherents caused riots in Paris, Nancy, and Toulouse, in which their party so greatly outnumbered all others from the first that they kept the upper hand.

People wondered how it was possible that a general who, as minister of war, had made enemies everywhere by his reckless bearing toward his subordinates, and by his ingratitude toward his benefactor and former chief, the Duke d'Aumale, could draw about him a body of followers from different parties. The answer was that he succeeded in attracting public attention by awakening the hope that he would undertake a campaign against Germany. Even when minister of war he made a beginning, and it is known that during the negotiations in relation to the Schnabele incident he proposed the demand of an ultimatum from Germany, which was prevented only by the prudence of Flourens and several other ministers. The crowd applauds a resolute man, whether the object for which he is ready to offer his hand is wise and promises success or not. Boulanger himself said, "If I wished war, I would be a fool; if I did not prepare for it, a wretch," and he repeated these words to the electors of the Department du Nord. Experience, however, has taught that Boulanger's words cannot be relied upon, and that he changes his attitude whenever he thinks it to his advantage to do so. Soon after he became minister of war he sent a circular letter to the generals of divisions reminding them that it was the duty of the army to avoid politics, and he said in the chamber, "As long as I am chief of the army, it is not to judge, but to obey." As general of a division he did not consider himself bound by these rules, but disregarded them in the most reckless manner. That does not throw a good light on his character, although his fickleness has not injured his interests.

Boulanger enjoys the protection of the Bonapartists, because they hope to gain control through him. Prince Victor Napoleon supported Boulanger in Perigueux as well as in Lille, and sacrificed large sums for his sake. Boulanger was not a candidate in either the department of Haute-Savoir or of Isere in the election of April 30, but that is no proof that Boulangism is

GENERAL BOULANGER.

approaching its end. The Count of Paris made scarcely any impression with his manifesto. He was accused on all sides of imitating the example of the general. The extreme left and the active group of the patriots' league remain true to Boulanger, and a party was formed in the chamber to sustain him. The members of this party hesitated to declare for Boulanger outside of parliament, and therefore most of them declined his invitation to a banquet in the Cafe Riche in Paris, but the party interests seem not to have been jeopardized by this refusal. The programme of Boulanger—dissolution of the chamber and revision of the constitution—finds supporters in nearly all parties. Only the Opportunists stand in determined opposition to the followers of Boulanger, and for this reason the cry "A bas Ferry!" is everywhere heard with the cry "Vive Boulanger!"

His opponents have tried to make Boulanger ridiculous, using his person as the subject of many caricatures. On one side he is overwhelmed with homage and on the other with insult; but he shares this lot with all those whose names are connected with a public movement. Boulanger has laid himself open to ridicule by imitating Napoleon I., assuming his manner of speech and adopting his favorite flower, but scorn is met by admiration, derision by flattery, and which of the two opposing powers will gain the upper hand has not yet been learned.

President Carnot undertook a tour of Western France to counteract the Boulanger fever, and without doubt the success of the Republicans was due to this. At least, this much has been gained: a revolution which would place Boulanger at the head of the government is not to be feared at present.—*Illustrirte Zeitung.*

OIL FILTER FOR GAS ENGINES.

GAS engines are generally lubricated too abundantly, especially if it be necessary for the attendant to leave the engine for a longer or shorter time without supervision, in which case he prefers to arrange for an excessive supply of oil rather than run the risk of a breakdown owing to insufficient lubrication. In consequence of this state of things, the quantity of oil which passes through the engine is far greater than that required to insure all the bearing surfaces remaining in good condition, and it becomes a matter of importance to be able to use the oil over again. This, however, cannot be done without careful filtration, and for this purpose M. E. Ducretet, 75 Rue Claude Bernard, Paris, has devised a special apparatus to be attached to gas engines, in which the oil coming from the cylinder is filtered hot.

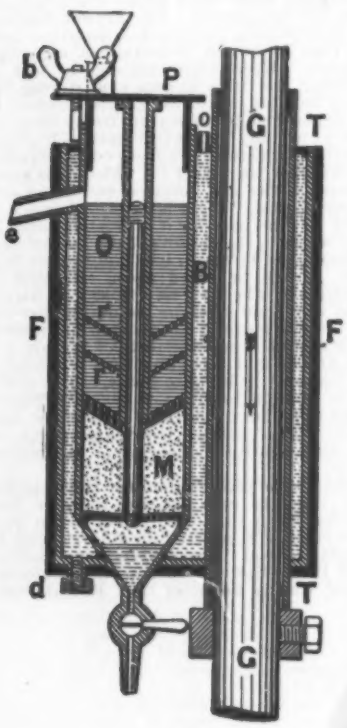


FIG. 1.

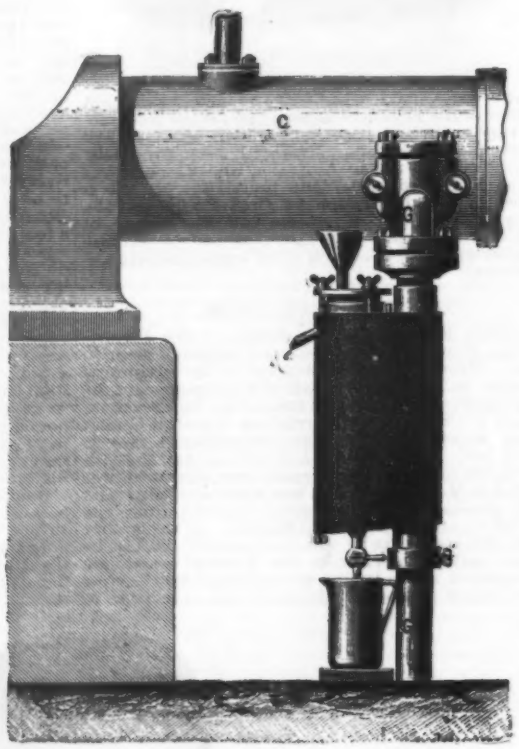


FIG 2.

OIL FILTER FOR GAS ENGINES.

The manner in which the apparatus is attached to the engine will be seen from Fig. 2, where C represents the cylinder of the gas engine, and G G the exhaust pipe round which is placed the filter. The used oil is poured into the funnel at the top until a drop of oil appears at the spout, *e*, showing that the filter is full, and the filtered oil is drawn off through an ordinary stop cock into a can beneath. The details of this apparatus will be understood by reference to Fig. 1. By placing the filter round the exhaust pipe, the heat of the escaping gases is utilized to raise the temperature of the oil under treatment, which greatly facilitates the process. The filter itself is contained within an outer vessel coated on the outside with some non-conducting covering. This outer vessel is traversed by a tube, T, and forms an oil bath, the tube having for its object partly to render the vessel independent of the exhaust pipe, and partly to prevent the oil in the bath from being injured by the excessive heat of the exhaust tube.

The filter consists of a cylindrical vessel, having the spout, *e*, already mentioned and a loose cover, P, which can be screwed down by the thumb nuts, *b*, so as to compress more or less, by means of a hollow central tube and perforated plate, the filtering medium, M, which is generally composed of compressed cotton. The grosser impurities are retained by the perforated plates, *r*. The oil from the bath can be drawn off by the plug, *d*, and a vent hole, *o*, is provided at the top to allow for expansion. We learn from the inventor that one of these filters has been in constant use at his own works during the last nine months, and has resulted in a great saving of oil.—*Industries.*

CHLOROPHYL AND GELATINE-BROMIDE PLATES.

By FRED. E. IVES.

THE isochromatic processes now most used are incapable of producing correct monochrome photographs of objects in all colors; eosine and erythrosine plates are insensitive to red, and even cyanine plates will not show any difference between a black and a deep red without greatly over exposing orange and yellow. The original process collodion emulsion with chlorophyl) is the only one yet published which has not this defect.

But most photographers do not like to use this process, because suitable chlorophyl cannot be procured at all times, nor preserved without considerable loss of sensitiveness, and the plates must be prepared immediately before use, and exposed wet, in a strong light. Many who have seen the beautiful results obtained with this process have lamented the fact that chlorophyl could not be applied successfully in the gelatine plate process, and I tried many times to accomplish it. On several occasions, I obtained considerable color sensitiveness, but the result was so uncertain as to be puzzling and discouraging. At last, however, I have succeeded in securing, by a surprisingly simple procedure, the full action of chlorophyl upon commercial gelatine-bromide plates.

The degree of color sensitiveness obtained appears to bear a definite relation to the general sensitiveness of the plate employed, which should, therefore, be of the most rapid kind. They are prepared by flowing with the alcoholic solution of chlorophyl, *then drying* rapidly, *then soaking in water* for at least five minutes, after which they may be used at once. With two-year-old chlorophyl (obtained from suitable leaves, at the proper season, and preserved with zinc powder in the solution), the absolute color sensitiveness is fully equal to that of commercial "orthochromatic" plates, and so distributed as to be capable of giving far more accurate results; but the blue sensitiveness, which is reduced by cyanine and erythrosine, is actually increased by chlorophyl, making it necessary to use an extra deep orange color screen with these plates. This excessive blue sensitiveness is, in fact, something of an objection to the plates, because it is not easy to get a color screen that cuts off just the right amount of blue light. With screen and exposure that would be exactly right for the commercial "orthochromatic" plate, the chlorophyl plate would be far over-exposed, with five or ten times too much action in the blue and violet. But if the color screen is deep enough, the resulting negative is perfect for all colors.

For purpose of comparison, I have made one photograph of the solar spectrum on a very rapid gelatine-bromide plate, treated with chlorophyl, and another on a commercial "orthochromatic" plate. A yellow screen was used to reduce the action at the violet end of the spectrum, and both plates received the same exposure. The total amount of action below the Fraunhofer line, E, is about the same in both plates, but in the commercial "orthochromatic" it is mostly confined to the yellow, while in the chlorophyl plate it is pretty evenly distributed throughout the yellow green, yellow, orange and red, down to the Fraunhofer line *a*.

In view of the fact that chlorophyl has been tried with gelatine-bromide plates a great many times, and in various ways, without definite success, the most surprising thing about this method is its simplicity.

Since obtaining these results, I have read a very interesting paper by Capt. Abney, in which he calls attention to the fact that cyanine and erythrosine will impart color sensitiveness to a commercial gelatine-bromide plate when merely applied to the surface, as by flowing the plate with collodion or varnish in which a little of the dye is dissolved. He concludes that contact of the dye with the surface molecules of bromide of silver in the plate is all that is required to secure color sensitiveness, and suggests that chlorophyl should therefore succeed with gelatine-bromide plates if merely applied in that way, or in alcoholic solution. It will not; the subsequent soaking in water is essential to the production of color sensitiveness.

LATER EXPERIMENTS.

Since the above paper was read, exposures have been made upon dried plates, with the following results: The color sensitiveness proved to be about three times greater than before drying, and the blue sensitiveness considerably less. The dried plates invariably fogged, and it was necessary to use a brush to prevent the formation of air bells and force an even action of the developer.

EXPERIMENTS WITH ERYTHROSINE AND CYANINE.

The discovery that chlorophyl would act so well when applied in the above-described manner suggested the idea of trying other color sensitizers in the same way. Plates were therefore prepared with erythrosine, by flowing with alcoholic solution,* then drying, then washing or soaking in water. The result was a great surprise. Although not a trace of ammonia or silver was used, the plates showed several times more absolute color sensitiveness than the dried chlorophyl plates (but all in the yellow and green), and about ten times more than the commercial orthochromatic plates. They work clear and brilliant, and are sensitive enough for portrait work with the yellow screen.

Cyanine was then tried in the same way, and gave even more remarkable results than erythrosine. Without reducing the blue sensitiveness in the least, it made an extra rapid plate as sensitive to the orange red, orange and yellow of the spectrum as to the blue, and as sensitive to the green as to the violet. The absolute color sensitiveness is many times greater than was ever before produced by cyanine, and ten times greater than has been produced by chlorophyl. The first plates that were prepared in this way gave only a mass of fog; the successful plates were washed and developed in total darkness.

One very important fact, discovered in the course of these experiments, is that the action of the dyes, by whatever method applied, is at least three times greater on some commercial plates than on others. The best plates I know of have a full allowance of bromide of silver, in a very thin film of gelatine.—*Jour. Franklin Institute.*

THE ILLUMINATING AND EXPLOSIVE POWER OF NAPHTHA GAS.

IN a recent number of *Dingler's Polytechnisches Journal* there appeared a communication from MM. Jawein and Lamonsky on the effect of the admixture of air on the illuminating power of naphtha gas, and on the explosibility of such mixtures. An abstract of the article, by Dr. S. Hamburger, is contained in the current number of the *Journal of the Society of Chemical Industry*, from which we take the following particulars.

Naphtha gas is manufactured in Russia from naphtha and naphtha residues, and is used for illuminating works and public buildings which have gas works of their own for this purpose. Owing to the difficulty of obtaining a general average sample of naphtha gas, the experiments were made on one day; the quantity of gas required being led into a small holder, which also contained the air for mixing. The mixtures thus obtained were tested as to specific gravity and illuminating power, and gave the following results:

Gas mixture.	Specific Gravity.	Consumption of gas in cubic feet per hour.	Illuminating power in candle units.	Consumption of gas in cubic feet per hour and candle unit.
Naphtha gas.....	0·685	3·3	31·0	0·107
Naphtha gas mixed:				
With 5 per ct. of air	0·719	3·3	25·0	0·132
" 10 " "	0·732	3·3	21·0	0·157
" 20 " "	0·755	3·4	15·0	0·226
" 50 " "	3·796	3·3	5·5	0·600

In all these experiments the gas was allowed to escape under a pressure of 6 inches, while the temperature of the room was from 19° to 21° C. It will be noticed that an admixture of air increases the specific gravity, and considerably diminishes the illuminating effect. For ascertaining the explosibility of mixtures of naphtha gas and air, different mixtures were submitted in a eudiometer to the action of the electric spark, with the following results: 1 volume of gas with 4·9 to 5·2 volumes of air did not cause any explosion; with 5·6 to 5·8 volumes, a feeble explosion; with 6 to 6·5 volumes, a violent explosion; with 7 to 9 volumes, a very violent explosion; with 10 to 13 volumes, a violent explosion; with 14 to 16·6 volumes, a feeble explosion; with 17 to 17·7 volumes, a very feeble explosion; with 18 to 22 volumes, no explosion whatever. A mixture of naphtha gas and air is, therefore, explosive if gas and air be in the proportion of 1 to 5·6 to 17·7 by volume, or 1 to 85 to 94·4 by weight. Of course, these figures are only accurate for the sample of naphtha gas experimented upon. After all, it is not likely that the figures will vary much with different naphtha gases; the proportion for marsh gas being 1 volume of gas to from 6 to 16 volumes of air.

* Erythrosine, 1 gr.; alcohol, 4 oz.

EVAPORATION OF MOISTURE FROM VARIOUS SUBSTANCES.

A CONDENSED statement of the practical results obtained by a series of extended operations of large drying establishments, and numerous carefully executed tests of evaporating apparatus, on a variety of damp or wet products, carried out through a period of twelve years, under the personal supervision of S. E. Worrell, of Hannibal, Missouri.

Substance.	Average Percentage, by Weight, of Water Extracted.*	Maximum Temperature of Metal Surface or Air Currents, Fahrenheit.†	Average Cost of Operation per Ton (2,000 lb.) of Dried Product.‡	Common Methods or Drying Devices Used.	Principally Used for.	Remarks.
Barytes or "tiff," after draining six hours.	0·020	250°	$0 20	Hot pans.	Paint.	Previous to the drying operation, the raw material is crushed and washed to remove the dirt.
Blood	0·850	200°	3 25	Hot rooms and steam machines.	Fertilizer.	The fresh blood is first coagulated by heat, then subjected to heavy pressure, which removes the bulk of the water and some oil. The residue being dried.
Bones	0·400	225°	75	Hot ovens.	Fertilizer.	A refuse from glue works. The bones are dissolved by acids or ground very fine. Improved apparatus are wanted for this obstinate material.
Beef, lean, fresh chopped	0·690	220°	9 75	The "Hercules" steam drier.	Condensed food.	Not yet commercially established. Retains its full strength while reduced three-quarters in bulk. Water wholly evaporated. "Desiccated" meat does not require salt or air sealed cans to preserve it. §
Brick, common "mud"	0·220	185°	12½	Hot ventilated rooms or tunnels.	Buildings.	This process is being adopted by large manufacturers, chiefly to save the delays of damp weather in making "mud" brick. Improved appliances are in demand for this purpose.
Clay, freshly excavated	0·210	225°	20	Air dried in open sheds.	Dry pressed brick.	For the reason just mentioned, and to save room and cost of sheds, drying machines will soon be adopted by these manufacturers.
Clay, ocher	0·260	200°	40	Hot rooms and steam pipes.	Paint.	The objectionable discoloring and clodding of present methods could be obviated and expense reduced by drying machines having a pulverizing action.
Coal screenings	0·180	225°	20	Revolving cylinders.	Fuel.	
Distillery feed or "slop"	0·890	220°	....	...	Valuable stock feed.	Not yet practically accomplished, but must soon be adopted, owing chiefly to the rapid increase of infectious diseases among distillery fed stock.
Grain, damp	0·029	210°	25	Worrell's drier and cooler.	Food.	The largest portion of this product is injuriously mixed with dry grain by "mixers," who sell it as all O. K. It should be dried.
Grain, soaked 24 hours	0·400	220°	50	Malt kilns.	Feed.	If dried quickly before germination begins, it retains most of its life and strength. The expense noted can be reduced.
Gravel	0·080	500°	12	Hot pans.	Roofing.	
Infusorial earth	0·300	220°	25	Air dried in open sheds.	Absorbent and non-conductor of heat.	For the same reasons noted above, after brick and clay, it would be advantageous to dry this mineral on a machine.
Salt, after draining 4 hours	0·120	200°	30	Steam apparatus.	Food.	Although many different devices are used for this purpose, there is a strong demand for better ones.
Sand, fine, after draining 24 hours	0·098	500°	50	Hot pans.	Glass.	One of the simplest materials, but difficult to dry cheaply. The writer has lately introduced a new machine for this substance that greatly reduces the noted cost.
Sand, coarse, after draining 24 hours	0·035	500°	50	"Stoves."	Locomotives.	
Sawdust, green white pine	0·330	275°	30	Steam and fire apparatus.	Fuel and refrigerators.	Take notice, inventors. The immense quantity of this valuable material annually wasted in the United States can be profitably utilized for paper, lumber, woodenware, fuel, etc.
Starch feed, "bran"	0·680	220°	3 75	Steam devices.	Stock feed.	Nearly equal in value to wheat bran. Most of the water is pressed out before the drying operation, which is generally required by the three articles just following below.
Starch feed, "gluten"	0·850	220°	4 25	Steam devices.	Stock feed.	Very rich in protein and carbohydrates. Equal to corn meal as a fattening feed.
"Tankage," pressed pork and beef	0·610	220°	3 40	Steam devices.	Fertilizer.	Largely consisting of bones. The preliminary squeezing extracts considerable grease with the water.
Wet "grains," brewers'	0·680	220°	3 25	Steam devices.	Stock feed.	Has been a favorite feed in the European market for years. United States brewers will soon adopt some drying process. Dried "grains" is a very rich feed, and sells for $1.50 per 100 lb. in England.
White lead	0·400	215°	50	Copper pans.	Paint.	The required purity of color and its acid nature makes this a very delicate substance to handle. New driers wanted for it.
Corn meal	0·018	350°	22	Steam devices.	Food.	This sweetens and preserves it for distant consumption. Is positively required when exported to tropical countries. The corn is sometimes kiln dried before grinding.

* This includes the water pressed out where a squeezing action is mentioned. The product is taken as *commercially dry.*
† A higher temperature is injurious. In some instances a lower degree of heat is advantageous.
‡ On a large scale, and liable to fluctuate with the cost of fuel, labor, etc.
§ Will eventually become an important addition to the concentrated foods for army use.

S. E. WORRELL, Hannibal, Missouri.

SIMPLE DEVICES FOR CUTTING OUT LANTERN SLIDE MATS.*

By JOS. P. BEACH.

THE costly nature of lantern slide mats as now supplied by the various stock dealers has led me to devise a simple plan by which an amateur may make hundreds of mats at cost of a dozen when you have to buy them. And as the mat very often has a great deal to do with the proper setting off of the picture, it is well for the amateur who is interested in this subject to provide tools for producing varied sizes and shapes to fit any given picture.

My method consists in taking a block of hard mahogany, apple tree or pear tree wood with the end grain upward and about an inch and a quarter thick, and as large in size as an ordinary lantern slide plate, and marking on the surface with a lead pencil the form and size of the mat you want, but perhaps a trifle smaller than an actual size. Then with proper tools, chisels, and files I take off of the block, a half an inch in depth, the wood, until it assumes the oval or square marked out.

I back up the mahogany block with half an inch of a softer kind of wood, securing it by screws, and bore a hole through the center three-eighths of an inch in diameter. This permits the air to reach the center.

Around the wood form thus made I bend an ordinary clock spring, which can be bought very cheaply, and is usually about three-quarters of an inch wide, and secure it to the wood by screws.

I prefer to do this with the aid of a vise, putting in one screw at a time until the circuit is completed. The pressure of the vise holds the steel against the wood, in place, until it is fastened by the screw.

Before the steel is bent around the wood form, holes for the screws should be punched with a blunt-faced punch where needed, and be afterward reamed out. Five screws generally answer. The steel should be laid on a piece of hard wood or a block of solder for this purpose.

If the spring is too hard to punch a hole through it, then take out the temper by heating in a stove and cooling by throwing into a bed of ashes. It will be seen that the thickness of the spring, about one thirty-second of an inch, will be too great to cut the paper clean and sharp. Hence I advise filing down one edge, which is to form the inner edge, before it is attached to the block, finishing with a very fine file. In putting it on the block it is necessary that the ends come close together. They may be allowed to lap a trifle, which can be afterward filed away. I generally use a pair of pliers and a hammer to partially shape it around the block.

For making square shapes, it is better to obtain thinner steel than the clock springs, for if they are used, the temper of the steel has to be removed.

Special thin steel can be obtained from most dealers in machinists' tools and supplies, while the old, worn-out clock springs can be bought for a song from any large clock company.

To cut out the mats, I simply fold up a sheet of paper 8×10 in size until it is four layers in thickness, and of the conventional lantern size pattern, then place it over the steel die; upon the paper I put a piece of mahogany wood with the end grain in contact with the paper, and by light, quick taps of the hammer on the wood the mats are quickly made, and your die is still ready for hundreds more.

The hardwood can be bought from dealers in engravers' and printers' blocks, at the corner of Dutch Street and Fulton Street. I submit for your inspection two forms as specimens, one oval and the other square, also several sample mats made on this plan. I think you will agree with me that the process is very simple, and one of great usefulness to the amateur who enjoys the making of lantern slides.

* Read before the Society of Amateur Photographers of New York.

TELEPHONY—A STATUE FOR THE NEW POSTAL BUILDING AT LUCERNE.

SWITZERLAND is not over-rich in fine monumental buildings. It seems almost as if in a country where nature has raised such gigantic structures to heaven man renounces all competition, while in level lands immense, artistic mountains of stone are often the only prominent objects which strike the eye as it sweeps over the horizontal expanse. But of late years much has been done toward beautifying the cities with noble edifices. Zurich, Bern, Genf, Lausanne, have watched the growth of elegant buildings dedicated to the public service; and why should Lucerne hold back, Lucerne, which has become a "tourists' city" of the first rank since the opening of the Gothard railroad? And when the government has to build a habitation for the postal department, that profitable factor of the treasury, it is right that nothing should be spared.

Consequently, a federal postal building has been erected in Lucerne from a beautiful design, the work of Messrs. Muralt & Gull, of Zurich, to whom the first prize was awarded. The building, which will soon be dedicated and occupied, turns its richly adorned front toward the lake, forming a charming and worthy ornament for the city on the *Vierwaldstättersee*.

TELEPHONY—A STATUE FOR THE NEW POSTAL BUILDING AT LUCERNE.

The accompanying cut shows one of the four statues which were prepared for the structure by Mr. A. Lanz, a Swiss sculptor, living in Paris. The young girl, who appears from her listening attitude "to be all ear," is the allegorical representation of the youngest of the institutions connected with the postal department, the telephone. The idea of listening is imprinted almost recklessly on the face and figure, for certainly the attitude of listening to distant sounds is not favorable to the animation of the face with the charm of intelligence. Even the wisest person would appear less intelligent than usual under such conditions. Mr. Lanz's representation is very true to nature in this respect, and in it the Swiss will recognize a type of simple Swiss womanhood. Mr. Lanz's other statues represent, with more or less conventionality, the Post, the Telegraph, and Nautical Intercourse.

The sculptor, who is still young, lately experienced a happy triumph. The city of Yverdon on Neuenburg Lake is going to erect a monument to the teacher Pestalozzi, and the first prize was unanimously awarded to the design presented by Mr. Lanz.—*Illustrirte Zeitung.*

[JOURNAL OF THE SOCIETY OF ARTS.]

DRAWING, A MEANS OF EDUCATION.

By T. R. ABLETT.

THE term drawing, as used in this paper, includes the representation of form by any process suited to the requirements of schools.

There are several points of view from which the teaching of drawing may be regarded.

1. With some, it is an accomplishment by means of which the glowing landscape, or picturesque ruin, is copied from the radiant chromo-lithograph, and made ready for the hands of the frame maker, by the united efforts of the pupil and drawing master. This, by the way, is an unfortunate partnership, and morally indefensible, when the master does most of the work, and the pupil takes all of such credit as is to be had.

2. Others teach it as a method of improving design in manufactures—the South Kensington plan.

3. The Royal Commission on Technical Instruction recommend it to be taught as a necessary element in what is known as technical education.

4. The Royal Academy teaches it as a training for artists.

5. Drawing, taught as a means of education, is a view of the matter which, unlike the others, has received very little attention, and is little understood.

If, in explaining it, my remarks are not always acceptable to those who deal with drawing from the other points of view which I have mentioned, I feel sure that it will be granted that different aims necessitate different methods. My duties have brought me into connection with a multitude of schools, of all grades, for boys and girls, and also with studios, and schools of art, English and foreign. I affirm, without hesitation, that the methods employed for teaching artists and designers quite fail to meet the legitimate requirements of schools.

The kind of training adapted to adults who have special talent for drawing, or urgent necessity for the attainment of skill in its practice, is, on the face of it, not likely to be suited to boys and girls at school, of whom the majority have no special aptitude, and all have little time for practice. Drawing has hitherto been for the few, and the methods of the drawing teachers of the past, and to a great extent of the present, are unsuitable, because they have been developed merely for pupils possessing unusual ability. The intellectual processes are slipped over or slurred, because these pupils possess a sort of intuition that takes the place of conscious or vertebrate thought.

Before stating the advantages of teaching drawing as a means of education, it will be useful to consider how and by whom drawing is found to be helpful. For technical or trade purposes it is constantly used by architects, engineers, military and naval men, advertisers, designers, and numerous others; for purposes of information, education, æsthetic gratification or culture, by geographers, astronomers, scientific men, statisticians, mathematicians, decorators, illustrators, or artists.

Artists may disclaim all connection with education, but scarcely with drawing, although one sometimes hears one artist say of another, "He cannot draw." Many artists can profess to know little of the use to which drawing is put by a number of the workers already mentioned, still, as a matter of general education, something should be taught of these various modifications of the art.

The late Right Hon. W. E. Forster once said to me about drawing: "I tried at school, but I, and most certainly my master, had to give up the hope of my being taught." What was the kind of drawing which Mr. Forster tried to learn? Probably the aforesaid accomplishment.

Is it not a reproach to art teaching that its methods have been so unintelligible, or wanting in their demand on intellectual effort, that a man of such distinction should have been able to make this confession? Is it not a reproach that at the present day, in many schools, drawing should be classed with dancing, and that there is an unspoken feeling in the community that the study of drawing is vague and unsatisfactory, and not to be classed with the purely intellectual or absolutely necessary studies? Only last year the head master of a large grammar school, which I examined for the first time, said in reply to one of my suggestions, "He could not permit progress in drawing to affect a boy's chance of promotion from one form to another."

Two things are necessary to raise drawing to a position of dignity in schools.

First, we must show that it may be made one of the bases of education, and one that all modern society owes to its children, whatever their avocation or their destiny.

Secondly, it must be demonstrated that it can be taught by collective or class methods as easily as reading, arithmetic, or any other school subject.

The educational advantages of teaching drawing are these:

A. Educational drawing is valuable as a discipline for training and calling forth certain powers and faculties of the mind which can be developed, to their full extent, by it alone.

The advantages arising from its practice may be summarized as follows:

1. *Perception of Æsthetic Influence is Quickened.*—Beauty is its own excuse for existing, and as the outcome of æsthetic powers or faculties it is absolute good.

2. *Accuracy in Observing and Thinking is Promoted.*—Drawing has to do with form and certain realities of the material world which it expresses.

All the facts representing the form, dimensions, and natural or mechanical structure of an object can be given by means of drawing, for it is a mode of expression which is unequaled in its power of conveying or of fixing an accurate idea of an object. For this purpose it ranks next to the object itself.

The observation is cultivated because, in certain branches of drawing, every minute particular of an object must be carefully noted.

We are all apt to be deluded by our eyes. Unless the mind can deduce facts from their appearance, its impressions may be altogether wrong.

3. *The Graphic Memory is Improved.*—Memory drawing obliges the observer to look at an object or form carefully and intelligently in order that the mind may retain the impressions gained as so much stored-up observation. The memory is brought into play in every act of drawing. Many artists can remember easily, because they have learned which are the salient points or features necessary for pictoric effect; and the best observers, outside the faculty, are those who have learned to fix in their minds the distinguishing or characteristic forms of faces, or places, and manifold other shapes of which it is useful to retain an accurate impression.

4. *The Imagination is Exercised.*—The mind must form a mental picture in connection with dictated drawing, also in designing working drawings of buildings, machinery, etc., but especially in composition connected with decorative or pictorial drawing.

5. *Free Scope is Afforded to the Creative or Inventive Powers.*—Drawing transcends either written or spoken language in supplying adequate means for making inventive thought manifest. By its aid a perfectly accurate idea of any object which exists only in the brain of the designer or inventor may be given.

6. *It Combines Training of the Mind, the Eye and the Hand.*—It is beginning to be understood that freedom of mind is to some extent dependent on freedom of body, that mental control is connected with physical control, and habit of mind with habit of body. If the senses and the muscles are led to form good habits, these will certainly react for good on the mind.

7. *The Powers of Description are Increased.*—The employment of precise language and nomenclature is to some extent necessitated by dictated drawing.

Drawing is a universal language. Not only is it a means of communication for those who speak the same language, but for all the civilized world. In its geometrical form it is written and read by inventors, engineers, architects, decorators, typographers, and others too numerous to mention. Through its power of representing the phenomena of nature, as they appear to the eye, it appeals in the most direct way to every human being. It enables the artist-poet to stir the emotions of all those who can appreciate beauty in form, sentiment, and poetic feeling, whatever be their nationality.

Those who aspire to take a leading or even active part in the doings of this and the next generation must not calculate too much on the requirements of the past, since the world's drama is being played on conditions which rapidly change. They will need the fullest development of the resources of the body, the senses, and the mind. Without practice in drawing this com-

plete efficiency cannot be attained. Educationalists are beginning to find the curriculum of schools somewhat overladen, and already recognize that the various pursuits, instead of being several and independent, are mutually helpful. It becomes apparent that they are interwoven one with another, and may be taught in their relationships. When this is fully realized in practice there will be less crowding, instead of more crowding, and where there is antagonism we may hope for harmony. This movement may be assisted by showing how drawing can be interlaced with other of the school subjects, which are already recognized as essential.

B. Educational Drawing Facilitates the Acquirement of Other Subjects.—Practice in drawing helps the acquirement of spelling, it is most useful as a means of impressing some of the facts of arithmetic, geography, history, and science, and writing is learned most expeditiously if coupled with it. Drawing is one of the very best methods of training the mind at an early age, and some of its definitions are admirably adapted to the capacity of the young.

English spelling demands a power of remembering the look of words, since their sound is not always a trustworthy guide. Everybody has probably written down a word to see if it looked right. The improvement of the *graphic memory* adds to the capacity for learning to spell.

The Arithmetic of Space is taught by drawing, as the arithmetic of numbers is by figuring. Why should every child learn one and not the other? The arithmetic of space may be taught as soon as a child can use a ruler and can understand something of drawing to scale. At first, it may well consist of drawing to scale, with the aid of a ruler, the common objects in a class room—such as the outlines of a door, a window, a blackboard, an easel stand, the walls, and the floor. It may be used to illustrate the methods of numeration. It is essential to the proper appreciation of the nature of a map. Fractions are made clear by its employment.

Again, the arithmetic of space may be used in learning many facts connected with geography, history, science, and other subjects. Facts, which in figures make no appeal to the mind, can be readily grasped by means of drawings, especially when they are made by the pupils themselves. When a child has to represent facts by means of drawings, it at once becomes plain to it that accuracy is of the first importance, and the difficulties of the drawing teacher are diminished to the extent to which this knowledge is acted upon afterward in the mere copying of shapes.

The Connection between Writing and Drawing needs no demonstration, although something has yet to be done to bring the fact into practical recognition. Why that worst of drawing tools, the pen, should be put into the hands of very young children it is difficult to understand. We surely ought not to cramp the little fingers at the onset.

A child may be taught to draw before it is possible or desirable that it should learn to write. The formation of the script letters is a difficult and tedious piece of drawing; still every one can learn to write, and therefore every one can learn to draw, at least in a way advantageous to themselves.

So difficult is the drawing required in writing, that it is well to prepare for it by encouraging as a preliminary step the spontaneous efforts of early childhood and the development of the senses of sight and touch. These senses must be carefully trained when they are most active—that is in childhood—or they will scarcely develop at all. The color blindness of an adult, usually incurable, has arisen in very many cases from the absence, at an early age, of the proper training of the perception of color, and clumsiness with the hands is attributable to similar want of culture. The sense of sight may be trained to some extent by the judicious choice of a child's playthings. Building bricks, which form a constant source of entertainment, may be cut in lengths of 1, 2, 3, 4 inches, and so on; they may also be colored. It is well to add colored spheres, cubes, cones, cylinders, and pyramids to the set. Differences in length, color, and shape will be noted in making selections for building purposes, and the distinguishing names will be learned incidentally, especially if the leader of the game calls for definite lengths, colors, or shapes. Only those who have undertaken to build in order to amuse children can appreciate the delicacy of manipulation that is often required.

A child's fondness for imitating produces in it a desire to make representations of things which are attractive or astonishing, long before its mind is sufficiently developed to enable it to cope seriously with reading, writing, arithmetic, and kindred subjects. This desire to draw should be fostered and encouraged. Fond parents are too apt to imagine that these aspirations to draw, common to all, are the manifestations of great artistic genius. These efforts should be directed into channels which will greatly help forward an infant's education, but they are often left to die away, because there is a presumption that the child possesses an exuberance of ability in this direction, and that its time will be more profitably spent in some other way.

Children are by nature diligent students, and drawing furnishes the most delightful mode of describing the things which interest them. We can assist the development of a child's powers, by encouraging it to follow up its ideas, and by putting into its hands those materials which will most readily enable it to carry out its intentions. Whether it follows any definite and logical plan, which some one has developed for it out of his or her inner consciousness, or whether it produces good drawings, is of little consequence so long as the faculties get scope for evolution and growth.

From a set of drawings, executed in this way by a boy between 3½ and 7, much may be learned. Most of the drawings were made from the recollection of striking things. A locomotive engine and train has been drawn many times. One can trace a gradual growth in the complexity of the drawings, which is coincident with opportunities for observing the objects and their details.

The following is a list of some of the things drawn: Steamer at sea; Greenwich Pier; a lifting crane; a train; designs cut out in paper, and colored; a lighthouse; viaduct; volcano; church; Beachy Head, with signal station; balloon; railway bridge over a river, with train; pier, steamer, and rainbow; plan of Hastings; design for a house; shooting star; stained glass window; Metropolitan and District Railways; maps; aquarium and menagerie combined; plan of railway; plan of a farm; Barnes Bridge during the Oxford and Cambridge boat race; and an angel flying down to a ship. Of animals—a horse, cat, dog, cow; birds and fishes have been attempted; a man drawn from life; and a caricature of a man frightening a cat away.

The tedious methods of teaching writing at present universally adopted are terribly wasteful of the precious hours of school life. The pupils feel little or no interest in what is simply a dreary discipline of copying lines. The time usually spent in learning to write amounts to something like 1½ years of school life. Yet experience shows that it is quite possible to greatly reduce this time, by making the practice of the curves of the letters as charming to a child as its own spontaneous efforts to make pictures.

In such spontaneous efforts in outline drawing the very young use the method of making a line which is employed in writing. Each separate idea, or perception of form, is represented by one effort of the hand. In drawing a man, for instance, a circle is swept in for the head, an ellipse for the body, and a straight line for each arm and leg. The finished artist sketches on a similar plan, for each stroke is the record of one observation. Although there is good reason for the childs's own method, yet we ignore it, and teach elementary drawing by a method of making a line which is quite different to that employed in writing.

The definitions employed in geometrical drawing may be taught quite early, as they do not present the same obstacles to the learner as those of most of the other subjects. For example, the definitions of grammar are subject to many exceptions, and it is extremely difficult to represent them as drawings which will appeal to the eye. They are mere abstractions of the mind, hard to understand and apply. The reverse is true of many of the definitions employed in drawing. They have no exceptions, they can be delineated so as to appeal directly to the eye, and, therefore, form an excellent means of introducing the nature of a definition to a child's intellect.

Such are the educational advantages which may be secured, in part or wholly, by everybody who can benefit by learning the other subjects of school work.

The capacity for learning to draw is just as widely diffused as the capacity for learning reading or arithmetic, and just as every one can acquire some knowledge and skill in those subjects, so every one can attain to some proficiency in drawing.

People who have not been taught to use the faculties which drawing affords, have to go through life deprived of a very important means of communicating with their fellow creatures. The interest in drawing which, by nature, children feel, should be cherished and encouraged so that it will continue throughout school life as a help to education, and that afterward it may bear fruit in increasing the capacity for enjoying the beautiful in nature or in art, and making easier such art work as the vocations of life require. To be able to make a drawing of an object, showing its correct dimensions, is a power which every one at some time or other needs to employ. Skill in this simple kind of drawing is, however, by no means common. Men and women of education and culture think it no discredit to have to call in the aid of a workman to do their measuring. The mistakes not infrequently made by the workman do not much disturb his serenity, however they may affect his employer, who has to bear the loss occasioned by them.

Drawing ought to be made an essential feature in every child's education. Too much must not be expected from the average pupil. Great excellence of manual execution cannot be attained by children. Many pupils have great intelligence, but little manipulative power; they can learn to draw in a way useful to themselves, and which aids the development of their faculties, but great excellence of workmanship is, with them, out of the question. Were manipulative excellence insisted upon at each stage, all energy and liking for drawing would be exhausted at the very first step. No one should be careless. The teacher may be satisfied if the pupil works up to the limit of his or her capacity. Where there is improvement there is hope.

Every youth should have a chance of showing his or her full capacity in each subject. It is pretty well known that children who are slow and inattentive in the usual school work may still have special aptitude for music, drawing, or the like. They should have a chance of distinguishing themselves in their own line without having to pass, as a preliminary, a difficult examination in other subjects for which they have little or no ability. Pupils of this description need careful management, as they are precisely those who lose interest and become listless if required to plod through a course of work which they find distasteful.

Perfection must not be expected in first efforts, however simple, and throughout the course the development of mere manual skill should not be regarded as the chief end in view, the aim being rather to give that culture which requires the use of drawing as the means or vehicle for conveying and expressing ideas.

Class or Collective Teaching.—The necessities of school management require that a large body of pupils shall be taught in mass, collectively, or, as it is termed, in class. Languages, mathematics, and the like have for many years been made to conform to such treatment. In order that all may learn to draw from objects or casts, it is necessary to find methods that will make it possible for the teacher to demonstrate as easily as a rule of arithmetic may be explained, the correct drawing of an object or cast exactly as it appears to the eye of each pupil.

There is very little doubt but that good collective teaching is more beneficial to the learner than the method by which each individual is taught separately, and no doubt at all as to the economy in time effected. With collective teaching each member of the class is being taught during the whole of the lesson, while by individual teaching each pupil, even with good management, is taught for only a minute or two during the same period. In collective teaching the progress of one's neighbor acts as a stimulus or warning, and its system of question and answer displays the subject from more points of view than would occur to any individual working alone. Lastly, the collective method greatly tends to make the teaching systematic.

Four conditions are essential to the complete success of collective teaching from objects or casts:

1. Good classification.
2. An object which all can easily see.
3. Approximately the same view of the object for all the members of the class.
4. A teacher well acquainted with class management and with the subject, and able to demonstrate the principles to be learned and methods to be followed with clearness and enthusiasm. Instruction without enthusiasm is scarcely worth the name of teaching.

As many of the class rooms in which drawing is taught are small, the second condition is often impossible of realization. This difficulty may be got rid of, however, by supplying every pupil with a reproduction of the same card, object, or cast, and causing each example to be placed precisely in the same relation to the eye of each individual.

The Teachers of Drawing as a Means of Education.—Bearing in mind what has been already said, it is safe to say that the teacher must have a knowledge of the general principles of school teaching, skill in teaching a class by collective methods, and such a general education as will conduce to the due realization of the interrelation of drawing with those school subjects which help it or are helped by it.

Such a teacher should be either a professional schoolmaster or schoolmistress, who has made a special study of drawing, or an art student who has had a good education, and who has acquired a knowledge of the principles of school teaching and skill in teaching a body of pupils collectively.

Some people, especially some artists, laugh at methods of teaching drawing. It would be just as wise for grown people, who read without effort, to ridicule method in teaching that art to children. The effort to learn to read is so great that any one but a child is tired out by it, yet teachers constantly instruct forty to fifty children simultaneously, and in a comparatively short time they all learn to read. If good methods produce this result in reading, why may not good methods be found for teaching drawing? Many artists prefer to rely on a sort of divine geometry—which measures nothing and takes no heed of exactness in number and proportion—instead of using what may be named the geometry of man. If they teach, they say to beginners, get a likeness; be only anxious about the masses; get the character or feeling of the model. If you fail to get your work right at once, clear the board and try again. But those experienced in the training of young people know that they must walk before they run, that they cannot draw as artists do, who have been years obtaining the skill which they display in a stroke. An experienced draughtsman can make up his mind what to do excessively quickly, almost unconsciously, but the beginner cannot proceed with the same ease. It is necessary to furnish him or her with methodical and connected exercises, which will bring him or her, in time, to judge proportions at sight, or almost instantaneously. The finished artist, inexperienced in school teaching, forgets what he had to go through to acquire his power. There are artists also who cannot be called finished, who have indeed but a very narrow idea of the range and resources of drawing, and it is these who are the most likely to wish for teaching. How many art students have been disheartened by the paradoxical way in which those artists who have not given themselves the trouble to think out and systematize their ideas deliver their dictums! Intelligent pupils get weary of a course of drawing, if they see that it lacks the method and system which they find in other subjects. A good teacher keeps boys and girls enthusiastic by giving them enough to do, by making the work interesting, and by rousing their curiosity and their constructive faculties. Interest in a course of study is soon lost if there is any loitering, or if it is continued too long after the freshness of novelty has passed. We learn few subjects finally. Those which interest us, or which we find useful, we probably return to again and again as years roll on. Many promising pupils are spoilt by the favoritism or injudicious praise of inexperienced teachers. Praise should only be given for that which costs self-denial and application, and not for latent talent, which costs the possessor nothing.

The possibilities of communicating knowledge and skill in drawing are not so narrow but that they will amply supply an extended school course. Drawing, well taught, should be an intelligent record of facts and impressions. There is as much, and a like, difference between a good and a bad drawing of objects, as they appear to the eye, as between an excellent and a wretched literary description. We cannot implant inventive genius and delicate feeling for art work where the germs of it do not exist, but we can bring to the knowledge of a student something of the accumulated experience of past and present ages. There are certain processes, certain facts, of form, light and shade, tone, texture, color, and elementary design, which form the elementary grammar of art, and these should be acquired to some extent by all, whatever may be the ultimate aim of giving such instruction. This grammar is capable of being taught systematically, like reading, writing, arithmetic, and the like. Just as these subjects are taught side by side, having each an allotted time, to large bodies of pupils, so may the different elements of drawing be taught.

An ideal course of study would be somewhat as follows:

The drawing of anything that interests a small child.

Memory drawing, letter pictures, and writing.

Use of the ruler.

Drawing to scale, with explanation of maps and diagrams.

The judgment, at sight, of length, proportion, height—compared with width, and angles.

Outline drawing from flat objects seen unforeshortened.

Color matching. Use of colors in maps, diagrams, etc.

The elements of practical geometry.

Statistical geometry, and the arithmetic of space.

The difference between real form and apparent form, as exemplified by the easier straight-lined geometric forms, as found in common objects and simple curves, lying in one plane.

Elements of solid geometry as illustrated in plans, elevations, and sections of common objects.

General review of the application of the various kinds of drawing.

Representation in outline of common objects as seen by the eye.

Description in outline of the appearance of plants, and casts of fruit, vegetables, and animals.

The simple principles of light and shade as shown by contrast, reflected light, aerial perspective, tone and texture in connection with monochrome objects.

The same, as exemplified in groups of objects which differ considerably in color.

Water color painting from objects.

Drawing and shading a head from the antique in chalk.

The simple principles of surface decoration.

Many pupils could only, as teaching is at present, obtain the broad outline and general principles of such a course as this. With the getting of so much, come the aforesaid educational advantages, such skill as is useful to everybody, and that intelligent knowledge of the rudiments of art work which increases the power of appreciating works of art. The designer and the artist have too long been hampered by the want of knowledge on the part of the public. Cultivate the taste of every boy and girl, and it will become much easier for the art worker to travel beyond the beaten track of obvious and commonplace conventionality.

Some pupils, with fair talent, will obtain that amount of skill which is the necessary preliminary step to the technical drawing of various professions and industries. Medical students who cannot draw are found to be heavily handicapped in competition with those who can.

It is unnecessary to mention the requirements of architects, engineers, and the like. The individual who can draw with ease and accuracy can gain skill in any kind of manual industry much more quickly than would be possible without such power. The drawing of an object is an excellent preliminary to the making of the same. The acquirement of accuracy in mensurement produces habits of precision that directly lead up to skillful handicraft. The difference between the skillful and unskillful workman is mainly that the former fashions his products the exact size required, and the latter makes them wholly or in part too big or too little for their purpose, and so wastes time and material for which the employer pays. It has been said that nine-tenths of the English workmen cannot understand a plan, elevation, or section. Waiting for the foreman's explanation increases the cost of production by wasting the workman's time.

Pupils who have decided talent for pictorial representation will lay a foundation upon which to build up, on leaving school, a thorough-going training in drawing and painting, such as will enable them to truthfully represent whatever is placed before them. So much power every artist should have as a preliminary to the painting of pictures. Poets, authors, musicians, dramatists, and painters all have a tale to tell, and each tells it in a way most suited to his faculties. We do not ask the poet to present his subject as an oratorio, nor the dramatist to develop his ideas with a palette and brush. We do expect a man, when he has chosen by what means he will introduce his theme, to show acquaintance with and skill in the use of the medium of his choice. Indeed, so much is such skill appreciated that many works of art support a reputation, not on account of the subject, but because of the technical skill displayed. There are pictures that delight artists, and no one else.

For nine years I was in charge of the art department of the Bradford Grammar School, and for six years of that time I also taught at the Bradford Girls' Grammar School. During this period the pupils had to begin the study of drawing by the exclusive practice of what is often spoken of as freehand. By various devices I strove to awaken and sustain an interest in its practice, but with indifferent success. It is wearisome to clever pupils because it requires so little intellectual effort, and uninteresting to the ordinary boy or girl. The process of lining in, however necessary for professional designers, chromo-lithographers, or engravers, cultivates in the young an unfeeling, mechanical method of dealing with a sketch which proves destructive of its best qualities. Those who have had long preliminary practice in the lining in of freehand acquire a habit which is most pernicious, and difficult to get rid of in after studies. Why should decorative or conventional arrangements of plants be given to a child before it has any power of drawing natural plant form itself? As in other educational matters, the proper way is to proceed from the known to the unknown. Our first lessons in drawing should be from things familiar and interesting.

Curiously enough, when I was asked, on my coming to London, to visit a number of High Schools, in order to find out why the drawing languished, I found the excessive practice of freehand was the chief cause of the mischief. I quote the written opinion of the head of a school as showing the general experience: "The continual practice of freehand is decidedly cramping to the pupils, and gives them a distaste for drawing." On receiving this confirmation of my own experience, it became a duty to devise a method of teaching drawing entirely free from objects. This system has met an acknowledged want in so far as is shown by the fact that many schools are working according to it, and from other schools in different parts of the country inquiries are frequently received.

The exhibition just closed at Lytham House, St. Alban's road, Kensington, showed how it is being worked in the schools of the Girls' Public Day School Company.

Some of the drawings exhibited in this and previous years are on the walls.

A most important point to remember is that these drawings are entirely the work of school girls. The teacher has not assisted in the manipulation or mechanical execution of them, but has been strictly limited to giving advice.

The characteristics of the annual exhibition are as follows:

1. Each school sends a certain number of careful drawings, illustrative of the work of the six divisions.
2. No pupil may send more than one drawing.
3. The drawings are certified by the head mistress as being the unaided work of the pupils themselves.

There is also an annual examination, the main features of which are as follows:

1. The teacher's power of giving a class or collective lesson is tested.
2. There is a succession of easy stages, one of which can be mastered each year by an average pupil.
3. Special provision has been made for talented pupils by the introduction of an honors paper in each of the divisions.

It may be well to state the aim of the work of each division, beginning with the most elementary.

Division I.

1. To develop accurate observation.
2. Connect writing and drawing.
3. Ward off color blindness.
4. Cultivate the perceptions.
5. Teach outline drawing from *real objects*, which present no difficulties in foreshortening.

Division II.

1. To call attention to the difference between the real and apparent form of simple objects and curves.
2. To cultivate the graphic memory.
3. By the *dictated drawing* to insure a knowledge of art terms, and give facility in working from verbal instructions.

Division III.

To teach the leading principles of drawing in outline the apparent form of the things of every day life.

Division IV.

To develop a useful power in drawing from rounded objects (plants and casts), that will serve as a stepping stone between drawing from simple objects and drawing from the antique.

Division V.

To give a knowledge of shading from real things. This will materially assist the pupil in acquiring the principles of painting.

Division VI.

To enable those who have shown capacity sufficient to pass the aforesaid divisions to begin the study of the higher branches of art.

It may be mentioned that a pupil in one of the schools had a picture hung in the Royal Academy at the same time that she passed in Division VI. of the course just sketched. This picture was painted in the afternoon class of the school by an ordinary schoolgirl.

Many of those present may take interest in the teaching of drawing sufficient to induce them to read the various speeches and paragraphs which appear in the daily papers respecting the advantages of introducing it into schools. Many may also have noticed how slowly we move in such matters in England. It would not be far wide of the mark to say that the teaching of drawing in nine-tenths of our higher schools is simply a farce when compared with the teaching of the other subjects.

The late Right Hon. W. E. Forster once said that the English people had a way of being late in every new educational movement, but that we generally managed not to be too late. We are certainly late in the matter of teaching drawing.

It is said by some that Englishmen are wanting in artistic feeling, and that it is no use wasting an art education on them; and others go so far as to say nothing can be hoped for in our climate. Yet we stand first in landscape painting, and in painting in water colors we are still without an equal. Can the descendants of the men who built our cathedrals be without art feeling? When England and its rivals have reached that stage in educational development when nothing that can be done is left undone, then those qualities of invention and imagination which have given such diversity to our school of painting will enable us to carry off the palm.

If I have succeeded in making clear the importance to general education of teaching drawing to every boy and girl, it is to be hoped that fewer in the future will have to go through the world without the aid of that marvelous descriptive power which it affords.

The capacities of the young are a mine of wealth from which it is to our interest to extract the ore. The faculties which are chiefly exercised in drawing can be developed easily in childhood, but with difficulty in adults. Let it not be said of us that we refused to work a vein of precious metal until all chance of working it successfully had passed away, for there can be nothing more depressing to a parent or teacher than that a boy or girl should, in after life, be able to point out wasted hours and wasted opportunities of school life.

THE PARALYSES.*

By J. T. O'CONNOR, M.D., New York.

GENTLEMEN: If on your way to college to-day you had overheard some passer-by say that a friend had been paralyzed, the word "paralyzed" would have conveyed no real meaning to you if you know anything of the subject. The ordinary non-medical person who hears the word used has, very likely, the idea that it means complete loss of muscular power, and the medical student does not need to go very far in his studies of physiology and anatomy to know that the word "paralysis" by itself may be applied to any one of half a dozen different conditions.

We will use the term to indicate a loss of nerve function in nerves distributed to muscles, although it is applied where the loss of function involves a nerve which carries impulses to secreting organs, and also nerves transmitting sensory impulses. In the latter case, however, the term anæsthesia is more suitable. You know from your studies of the past two years that one set of muscles supplied by one definite nerve may be useless to the individual, owing to a lesion in that nerve, or that one set of muscles not innervated by one nerve, yet having one combined physiological action, may be useless, as in paralysis of the anterior tibial or the peroneal group of muscles, the lesion in this case existing in certain aggregations of large ganglion cells in the anterior gray horns of the spinal cord. Here, then, are two cases in which groups of muscles may be useless, and yet the paralysis in the one case is to be differentiated from that in the other.

Then again there may be paralysis of one limb as a whole. This is of cerebral origin. But a paralysis of many muscles of one arm, especially in its upper part, is seen now and then. It is known as Erb's paralysis, and occurs in infants, and is caused by pressure made, during delivery, upon the brachial plexus, just above the clavicle. Such a paralysis may be mistaken for complete paralysis of the limb.

Paralysis of arm and leg of the same side is due to a lesion in the brain, in the motor areas for arm and leg in the cortex of the hemisphere of the opposite side. It is possible for an injury to one side of the cord in the upper cervical region to result in such paralysis, but there will then be something else—the sensations from the other side of the body will be impaired or lost. A knife thrust could thus injure one lateral half of the cord without injuring the other, but a disease process, such as myelitis, is not thus limited.

Facial paralysis is of two types. In the one known as Bell's palsy, the lesion is in the trunk of the nerve after it has emerged from the brain at the lower border of the pons. In this case all three branches of distribution of the nerve are paralyzed, the affected side of the face drops, the naso-labial fold is smoothed out, the patient cannot draw up the affected side of the mouth nor wrinkle the affected side of the forehead, while the distinctive feature of this form of paralysis is the inability to close the eye of the affected side—it stands open even during sleep, and the instinctive closure of the lids against foreign bodies is lost.

The cerebral type of facial paralysis, whether alone or as part of a hemiplegia, has the same symptoms, except that the eyelid is not affected nor the frontalis muscle. In this case the upper branch of the facial nerve has somehow escaped. But how? This has long been a puzzle to neurologists. It has been supposed that, on both sides, the eyelids and frontales muscles were innervated from both halves of the brain equally, or that there was a separate undiscovered nucleus on each side for the nerve fibers to these parts. When the nucleus of the seventh nerve, below the floor of the fourth ventricle, is destroyed, as it sometimes is, by disease, the eyelid and frontalis muscle escape, and I am not aware of any case of nuclear disease in which the eyelid could not be closed. The experiments of Mendel shed some light on the subject. He has shown that in the guinea pig and rabbit, when the young animal is deprived of the upper eyelid and frontalis muscle of one side, the wound allowed to heal and the animal kept until maturity, there is found upon post-mortem examination no degeneration of the facial nucleus; but there is positive and great degeneration of the posterior part of the nucleus of the third nerve, below the aqueduct of Sylvius. This, then, accounts for the clinical facts as we find them in man, and we can now readily understand that even in degenerative conditions in the whole of the third nerve nucleus we ought not to see the open eyelid of Bell's palsy, for the muscle that keeps it open (the levator palpebræ) is powerless, together with all the muscles innervated by the third nerve.

You have heard me use the terms motor area of cortex, nucleus of nerve origin, and nerve trunk—all in connection with the idea of paralysis. A word or two of explanation may be of service here. It is a law of the construction of the nervous system that an impulse from or to the cortex does not pass through a continuous fiber, but that there is interpolated somewhere in the pathway of transmission a nerve cell. This is very readily seen in the motor tract and in the tracts of the cranial nerves. The motor tract arises by prolongation of the axis cylinder process from each ganglion cell of the motor cortical area. The fibers, appearing white *en masse* from the presence of the myeline sheath, make up at first a part of the centrum semiovale, then converge into the internal capsule lying between the lenticular nucleus on the outside and the caudate nucleus and the optic thalamus on the inside. At the base of the brain they emerge in the crus, occupying the middle third of its pes, then passing into the pons they are separated, possibly ending there in part. At the beginning of the lower third of the pons the fibers from the cortical motor area for the face cross over the median line and end in large nerve cells found in that portion. This aggregation of cells we know as the nucleus of the facial nerve. From its cells new fibers arise to emerge at the lower border of the pons as the trunk of that nerve. The fibers for the upper facial distribution have probably come down from the posterior part of the third nerve nucleus by way of the posterior longitudinal bundle to join the fibers from the nucleus of the seventh.

Now, another word or two of explanation. It is known that when a nerve fiber is cut across, only a part of it undergoes degeneration, that is, the part cut off from its source of nutrition. At first consideration we might think that the peripheral portion would degenerate, but this is not always so, for some tracts of nerve fibers degenerate upward after injury along their course. Without going deeper into the physiological and anatomical details, I may say that degeneration usually occurs in the direction in which the fiber transmits impulses, and extends to the end of the fiber. Thus, in the motor tract a lesion anywhere will be followed by this secondary degeneration, whether the lesion be situated in the cortical motor area, the centrum semiovale, the internal capsule, the crus, the pons, or the spinal cord, the degeneration extending downward and ending with the termination of the fiber, that is, at its junction with a large motor cell in the anterior gray horn of the cord. We are thus furnished with a very important aid in diagnosticating a paralysis due to a lesion in the central half of the motor tract, that is, between the cortex and the ganglion cells in the anterior horn of the cord, from one due to a lesion in the peripheral half of the motor tract, that is, between the ganglion cells in the anterior gray horns of the cord and the periphery. Thus we see that the nutrition of the fiber in the central half is received from the cell of the cortex, but in the peripheral half it is from the large cell in the anterior gray horn.

In the sensory fibers of the spinal nerves the matter is not so readily understood. You know that these nerves emerge from the cord in two divisions or roots, an anterior, or motor, and a posterior, or sensory, and at some distance from their emergence the two roots unite to form one trunk. Now, upon the posterior root, before it joins the anterior, is a large aggregation of cells, forming what is known as the posterior spinal ganglion. The cells of this ganglion have something to do with the nutrition of the sensory fibers, but exactly what we do not as yet know. When a peripheral nerve is cut across, all of its motor fibers degenerate from the point of section outward, and this is so too of the sensory fibers, but the portion of the latter in connection with the posterior spinal ganglion is still nourished. If the sensory root is cut across between the ganglion and the cord, the peripheral, cut-off portion

* Being the introductory in a course of lectures on the symptoms of nervous diseases, given to the senior class of the New York Homeopathic Medical College, beginning January 9, 1888.—*Hahnemannian Monthly.*

does not degenerate. The ganglion, therefore, exercises a trophic or nutritional influence on the sensory fibers outward. But it also does this in an inward direction, for if the section be, as in the last instance, between the ganglion and the cord, we find that the fibers of the sensory root degenerate from the point of section upward, and this degeneration can be traced upward as far as the medulla at least. Moreover, if the ganglion itself be destroyed, the sensory fibers passing through it degenerate in both directions, centrally and peripherally.

Now, ordinary sensation is divisible into the sensations of touch, temperature, and pain, and also the muscular sense. By the latter we know the position of our limbs through information sent to our consciousness concerning the position, degree of tension, etc., of different muscles. The fibers for muscular sense enter the cord in the column of Burdach, and as we ascend to successively higher levels we find that the newly incoming fibers push toward the median line the fibers which entered below. Thus is formed the column of Goll. We shall consider these columns and their fibers in detail when treating of locomotor ataxia, but just here it will not be out of place to say that when a peripheral nerve is divided, although sensation and motion, as far as they depend upon the integrity of the injured nerve, are lost, the muscular sense in the territory innervated by the nerve is not lost. Hence we must assume that between the muscular sense fibers of one nerve and those of a nerve near by there must be a very full anastomosis in the terminal distributions.

In a case of paralysis confined to one limb, the loss of motor power in muscles innervated by one nerve, and the anæsthesia or paræsthesia in its sensory distribution, will enable you to say that the trouble is in that nerve. What the lesion is must be determined by extended examination—it may be due to a stab, or to pressure, or to neuritis of other origin.

If the paralysis in one limb exhibits itself in loss of power in muscles innervated by different nerves, and especially in muscles that act together in some one physiologically combined motion, and if there is no impairment of sensation, you must look for its cause to some diseased condition in the aggregations of large motor cells in the anterior gray horns of the cord.

Should the paralysis affect as a whole the two limbs of one side, remember the possibility of its being of spinal origin from injury, as already mentioned, but also remember the clinical presumption that its cause is in the cortex or the lower part of the pons, or in the medulla. If the face is involved, but on the side opposite to the paralyzed limbs, the lesion is in the lower third of the pons, while if face and limbs of the same side are affected, the lesion is above the last named site.

Paraplegia or paralysis of both lower limbs is due to transverse lesion of the cord. It may be in the lumbar or in the dorsal region. Here the loss of sensation, loss of power (usually) over the sphincters, and the girdle sensation will call your attention to the cord as the structure at fault.

I have said nothing of the presence or absence of atrophy in the muscles. This begins at once on the occurrence of a lesion in the peripheral segment of the motor tract, that is, if the lesion is in the ganglion cells in the anterior gray horns of the cord or in the nerve itself. If the lesion is in the central segment of the motor tract, no atrophy follows except that which results from want of use. The large cells spoken of have a nutritional influence upon the muscles governed by them as well as upon the nerve fibers given off from them. The distinction between the slight atrophy brought on by want of use in a muscle and that resulting from degeneration in the ganglion cells or the nerve trunk is well differentiated by the use of the Faradic current, but this method of diagnosis must be left until we study the special symptoms of cerebral hemiplegia.

A form of paralysis involving one, two, three, or all the limbs is seen in severe cases of multiple neuritis. If the two lower limbs are affected, it may in some respects simulate paraplegia of spinal origin, while if the disease has not progressed very far, the diagnosis of a double sciatica may be erroneously made. The diagnosis of double sciatica is always to be received with doubt. Fortunately, in multiple neuritis the clinical picture is rather characteristic. The paralysis when present is usually limited to the peripheral half of the limb, that is, to the lower leg and the forearm and to the extensor more than the flexor muscles. The latter, however, is the case frequently in paralysis of cerebral or of poliomyelitic origin; so that we may almost believe there is some greater innervation to the flexors than the extensors. In a well marked case of paralysis from multiple neuritis the patient has "drop wrist," as in lead paralysis and musculo-spiral paralysis, and he has "drop foot," so that the point of the foot is directed downward. Hence, if able to walk at all, his gait is peculiar, the thigh muscles acting strongly to lift the "dropped" toes from the ground and throwing the fore leg forward, the foot then coming down with a flail-like motion. A similar walk is seen in some cases of poliomyelitis anterior, but in multiple neuritis the sensory disturbances will be of great service in diagnosis. Areas of anæsthesia surrounded by areas of hyperæsthesia, or *vice versa*, tenderness on pressure along the course of the nerve trunks, impairment of the temperature sense for heat and often hypersensitiveness of the limb to cold, will enable you to make up your diagnosis. The loss of sensibility to heat is sometimes so great that patients through their not appreciating the great degree of heat employed have been severely scalded by the application to the limbs of cloths wrung out of hot water.

COLLETIA.

A GENUS of shrubs from Chili, some species of which are hardy enough for the open air in all but the coldest parts. There are three species in gardens, all interesting and beautiful when in flower. They have spiny branches that are naked, or the few leaves are so minute as to appear absent. C. cruciata is the commonest kind; its stems are armed with stout, flattened spines, and its flowers are white and small. It makes a bush about four feet high. C. bictoniensis is the same as C. cruciata. C. spinosa (illustrated herewith) has its spines round or awl-shaped, and is a prettier shrub when in bloom than C. cruciata, as the white flowers, though small, are very numerous and produced in summer. Under favorable conditions, Colletia spinosa grows much taller than C. cruciata, and against a wall will attain a height of ten feet. The names of C. ferox, C. horrida, C. armata, all stand for C. spinosa. It makes a formidable hedge in the southern counties, where it flourishes to perfection. C. serratifolia is less common than the others, but is extremely pretty when in bloom, the whole bush being a

COLLETIA SPINOSA.

complete mass of tiny white blooms. It grows tall and slender, either planted in the open or against a wall.—*The Garden.*

BAMBOOS.

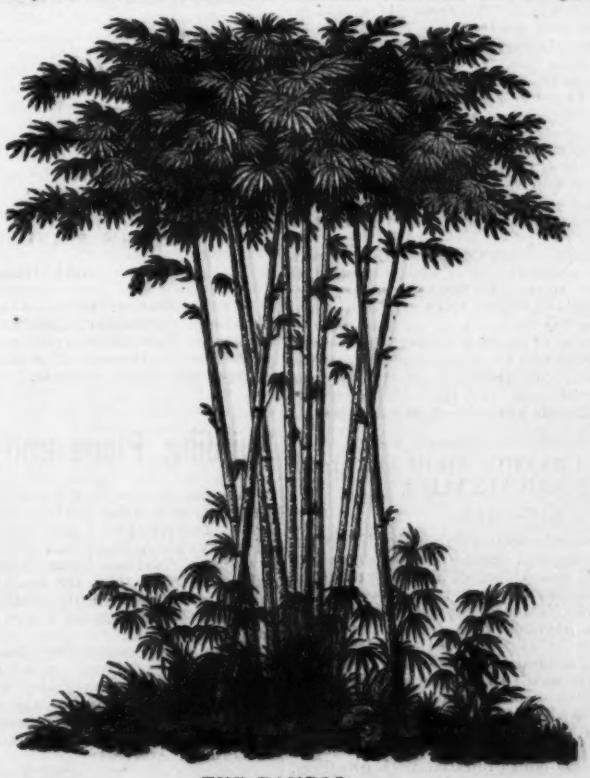
THE grass family, one of the most useful families of plants to man, is represented over the entire surface of the globe by numerous species. Those that live in our climate, and some of which are of prime necessity (as the cereals, for example), are for the most part plants of unpretentious size, but in equatorial countries we meet with species of astonishing proportions. Among these are the grasses belonging to the tribe Bambusaceæ, the typical genus of which is *Bambusa*, the species of which are properly called bamboo, from the Malay name. According to Stendel, there are thirty-three species, which are all natives of warm countries and have an extensive range over the surface of the globe.

Some of the species (such as *B. aspera* of the Indian Archipelago) rise to a height of 120 feet.

The variety of purposes to which these plants are applied is almost endless. The Chinese use one of the species in one way or another for nearly everything they require. The sails and masts of their ships, as well as the rigging, consist chiefly of bamboo, manufactured in different ways. Almost every article of furniture in their houses, including mats, screens, chairs, tables, bedsteads, and bedding, are made of the same material. A similar use is made of the hollow reed in Japan, and also in Java, Sumatra, and other Eastern countries. The young shoots of one of the species is covered with a dark green cortex, which the natives of Siam pickle. The young shoots of all the species can be cooked and eaten like asparagus, and the hollow culm contains a saccharine pith of a very pleasant taste. In India the thorny bamboo (*B. arundinacea*) is used for cattle-proof live hedges, as are also *B. nana* and *B. blumeana*.

In the Moluccas, one of the species of bamboo produces stems thick enough to serve, when slit into halves, for canoes. Among the minor uses to which the bamboos are put is the manufacture of canes, the largest and best of which are said to be the product of *B. arundinacea*.

Although the bamboo grows spontaneously and profusely in nearly all the immense districts included in the southern portion of the Chinese empire, the people do not rely upon the beneficence of nature, but cultivate the gigantic reed with much care. They have treatises and whole volumes solely upon this subject, laying down rules derived from experience, and showing the proper soils, the best kinds of water, and the seasons for planting and transplanting the useful production.



THE BAMBOO.

A CHINESE REPORT ON THE CONDITION OF CHINESE EMIGRANTS ABROAD.

IN the month of August, 1886, three high Chinese officials left Canton as an imperial commission to inquire into and report upon the condition of Chinese abroad. After thirteen months' absence, they returned in September last, having visited various Spanish, British, and Dutch colonies, and presented their report to Chang Chih-tung, Viceroy of Canton, who has addressed a memorial to the throne containing the substance of the commissioners' observations, together with recommendations of his own. The commissioners have since started on a tour in Borneo, with a view to study the condition of their countrymen in Sarawak, the territory of the British North Borneo Company, and the Dutch possessions, but no report of the results of this journey has yet been made.

The report of the first and most important journey begins at Manila, the capital of the Philippines, which was the first place visited by the commission. Here the Chinese community complained bitterly of the wrongs they received at the hands of the Spaniards, and earnestly begged for the appointment of consuls to protect them, volunteering to pay all the expenses of consular establishments. There are about 50,000 Chinese there, carrying on a most thriving business, notwithstanding the wrongs inflicted on them. They are murdered, their houses are set on fire and plundered, and the authorities sent to investigate the case evince flagrant partiality. Extortionate taxes are levied on them, and, groaning under the burden of their oppression, they were about to petition the Spanish government when the commission happily arrived. From Manila the members recrossed the China Seas to Singapore, where they were received with every civility by the governor. Here the Chinese number about 150,000, and are the richest among the inhabitants. Four-fifths of the landed property is theirs, and large numbers of Chinese laborers pass through the port

every year. A registrar-general is appointed to look after these, but the Chinese consul has no joint supervision with him, and hence deceptions and irregularities by the labor companies prevail. In Malacca and Penang the Chinese also thrive in business; in Perak and Selangore the 100,000 Chinese, mostly tin miners, are well protected. Several of them are millionaires. In Rangoon there are about 30,000 Chinese, dealing mainly in rice and precious stones.

From Rangoon the commissioners passed to the Dutch colonies, and first to Deli, in Sumatra, the center of a large area of tobacco plantations. To this place immigrants come mostly from Swatow, through Singapore, where they are carefully examined by English officials to ascertain whether they know where they are going, and whether they go voluntarily. They are mainly engaged in tobacco growing and curing, and the thrifty do well; but gambling is encouraged by the head laborers, and those who lose are compelled to remain working year after year. The Dutch laws provide that no laborer shall be engaged for more than three years, and that he shall be at liberty to go home after this period, whether he is in debt or not, but the laborers are ignorant of this, and are ill-treated in consequence. But the Dutch authorities promised the commission to have this rectified. In Batavia the Chinese are heavily taxed, and gambling prevails among them. In other Dutch possessions there are over 200,000 Chinese, who "are most outrageously treated by the Dutch authorities, and when the commission visited them, they all with one impulse poured forth their wrongs."

In Australia the commissioners visited a large number of places at or near the coast. "The island of Australia, which is a dependency of England, is one of the five great continents, of vast extent in area, and possessing the richest natural products. Minerals of all kinds are found there, and large numbers of Chinese emigrate thither to engage in mining and other occupations." A heavy tax, varying from £10 to £30 per head, is levied on Chinese landing there, the object being to prevent the immigration. Wherever the commissioners went, they received the most hearty and enthusiastic reception from their countrymen, who prayed that measures for their protection might be speedily adopted. "The number of Chinese subjects at present trading or working in foreign lands does not fall short of several millions, and in some ports the immigration is increasing, and our merchants are thriving. The advancing prosperity of our people has attracted the attention of the various foreign governments, and their jealousy has been aroused. The Dutch authorities have been endeavoring to expel the Chinese from their colonies, and collisions between the Chinese and natives are becoming of more frequent occurrence. If measures are not adopted to render the residence of our citizens abroad more secure and peaceful, they will all flock home, and what will become of this surplus population scattered along our sea coast? The question of affording efficient protection to our subjects abroad is, therefore, one that demands our immediate attention and solicitude. Wherever the commissioners visited, they were received with courtesy by the officials of the various foreign governments. But more especially did the English officials manifest their friendship and good will."

So much for what the commissioners saw. On this the viceroy makes various suggestions for the more efficient protection of Chinese emigrants, but practically they all resolve themselves into one, viz., the appointment of Chinese consuls abroad to look after the interests of their countrymen. Thus he wants to see consuls-general in Manila, in some one of the Dutch possessions in the Malay Archipelago, in Sydney, and in Singapore, with subordinate consuls and vice-consuls at various places in the Philippines, Java, Sumatra, Penang, Rangoon, Brisbane, Victoria, etc. Indeed, so important and urgent did he deem it to appoint a consul-general to Manila, that he got the consent of the government of Madrid for the purpose, but the Manila government objected, and the consent was withdrawn. In Singapore he would have the consul-general exercise a kind of co-ordinate power with the colonial registrar-general for the prevention of irregularities and deception on the laborers. The consuls would be supported out of the fees derived from the Chinese residents in the various places, and if there is a balance it could be reserved as a fund for the construction of war ships to be specially used for the protection of Chinese abroad. In addition a literary college should be established at Manila, with an adequate library, and a corps of professors selected by the consul-general to teach the Chinese youth there "the doctrines of our national sage, the ethics of China, the principles of the five relations," etc. If the fees are not sufficient to cover all expenses, the memorialist will raise the rest among the merchants, upon whom he will bestow official titles.

In view of the measures which Chang Chih-tung proposes to take for the protection of Chinese abroad, it may be well to explain that while foreign powers have the right to send consuls to China, the Chinese government did not secure for themselves in the treaties the corresponding power of sending consuls to foreign countries. The omission was due to simple carelessness, and perhaps to a belief on the part of the Chinese negotiators of the treaties of 1857 that China would never want to send officials abroad.—*London Times.*

SEPARATION OF URANIUM FROM ALKALINE EARTHS AND ALKALIES.

By A. REMELE.

THE author recommends ammonium sulphide as the best reagent for this purpose, except in case of barium. Recently Foullon and also Alibegoff find that uranium and calcium cannot be separated in this manner. Foullon recommends in this case the use of ammonium oxalate in a solution previously rendered alkaline by ammonium carbonate. He first mixes the hydrochloric solution with a little ammonium oxalate and then adds ammonium carbonate until all the uranium oxide is redissolved; ammonium oxalate is then added in excess and let deposit in the absence of strong light. Alibegoff, working in this manner, obtained better results than with ammonium sulphide, but the calcium oxalate was always more or less contaminated with uranium. He therefore adds to a solution of uranium chloride some elutriated mercury oxide, when the uranium is completely deposited on boiling, and the supernatant liquid has quite lost the color of the uranium salts. In case of uranium solutions in the oxygen acids, a solution of ammonium or sodium chloride is added. A very dilute solution of ammonium chloride is used for washing; as the precipitate, a mixture of uranyl hydroxide and basic mercury uranate, is slightly soluble in water. In carrying out this method the author adds to the solution of uran-oxychloride a few drops of an ammonium chloride solution, and heats to a boil. He then adds the pure elutriated mercuric oxide, carefully avoiding excess. After again boiling and shaking round (in preference to stirring), let cool, when the precipitate settles quickly, and the liquid becomes colorless. Decant a few times, bring upon the filter, and wash in cold water containing ammonium chloride. The precipitate along with the filter is heated in a platinum crucible, carefully at first, then in the uncovered crucible with a gradually increasing heat, and lastly over a blast. The product is weighed as the olive green uranious uranic oxide. In presence of uranium and calcium the process is the same. If the alkaline earths are in very large proportion, their partial precipitation may be avoided by boiling up once more after decantation with water containing ammonium chloride. In the filtrate the strontium and calcium are determined in the usual manner after removing the mercury with ammonium sulphide. Uranium may be separated from magnesium by boiling with a sufficiency of ammonium chloride and then precipitating with mercuric oxide as above.

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